JUL 23 1928

ENGINEERING AND
MINING JOURNAL

METAL AND NON-METALLIC MINING · MILLING · SMELTING · REFINING · MARKETING

McGRAW-HILL PUBLISHING COMPANY, INC. July 21, 1928 TWENTY-FIVE CENTS PER COPY

Electric Operation of Hoists

By Gordon Fox

■

The Miami Concentrator and International Smelter

By E. H. Robie

■

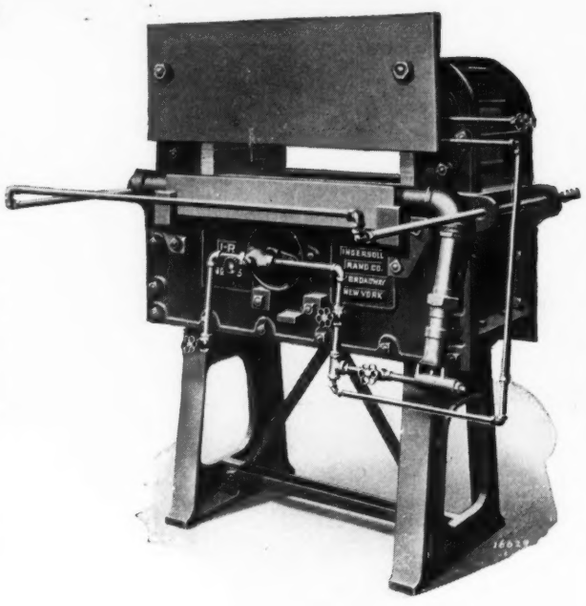
Mining Ore by Top Slicing

By Charles A. Mitke

■

An Electrified Kitchen in a Model Mine Boarding House

Perfect Heat Control —AND SO EASY!



ON EASE of regulation and simplicity of construction are based the popularity enjoyed by the I-R Oil and Gas Furnace for heating drill steels.

The furnace can be entrusted to any of your employees. One valve regulates the quantity of air, a second valve regulates the oil, and a third valve regulates the mixture of air and oil to the burner. These valves are readily accessible, and the flame is always under the control of the operator. Just as easy as A, B, C.

An I-R No. 25 Furnace and a "Leyner" No. 50 Sharpener are the most economical combination for treating your drill steel.

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ENGINEERING AND MINING JOURNAL

A consolidation of "Engineering and Mining Journal" and "Mining and Scientific Press"

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Contents

Editorials	81
Purpose and Craftsmanship Rather Than Mere Performance	
All Europe Now on a Gold Basis	
Simple Determination of Classifier Efficiency	
Good Weevil Season Encourages Arsenic Producers	
New Investment Trust for Mining Shares	
Foreign Exploitation of Soviet Manganese Fails?	
An Electrified Kitchen in a Model Mine Boarding House	84
Mining Ore by Top Slicing	86
BY CHARLES A. MITKE	
Electric Operation of Hoists	91
BY GORDON FOX	
Gold Production in California Slightly Less, Though Widely Distributed	95
Domestic Cadmium Production Increases One-Third	95
The International Smelter and the Miami Copper Concentrator	96
BY E. H. ROBIE	
Production of Abrasives in 1927	98
Useful Operating Ideas	99
Comment and Criticism	101
Consultation	102
Industrial Progress	103
Mining News	106
Personal Notes	112
Obituaries	113
Book Reviews	114
Market and Financial News	115
Freight Rates	117
Market Report	118
Mining Stocks	120

Technical and Industrial Service Directory	45
Searchlight Section	47-49
What and Where to Buy	50-52
Advertising Index	54

In Store for E. & M. J. Readers

Brakes for the Mining Industry

It may not be speedy enough to require them, in the opinion of some, but it may need both a service and an emergency brake all the same, as Dr. George Otis Smith explains in the July 28 issue. All mining men should be interested in intelligent economic control of their industry.

* * *

Safe and Efficient Mine Signals

Not every mine enjoys a foolproof signal system. Park Utah Consolidated, however, has one that may well serve as a model; it was well designed, in the first place, and it has proved its worth in practice. Details will be given next week.

* * *

Tin in California?

Well, not very much perhaps, but apparently the Temescal deposits contain more, at least, than do the alleged tin prospects in Oregon, with all the excitement that they have occasioned. An article by H. E. West brings *E. & M. J.* readers up to date on this subject.

* * *

Aërial Photography

A young Dayton engineer who has specialized in this subject will describe in an early issue equipment used in making aërial maps, tell what has been accomplished in this field, and give an idea of the cost. Interesting photographs, including one of the Grand Canyon from the air, are a feature.

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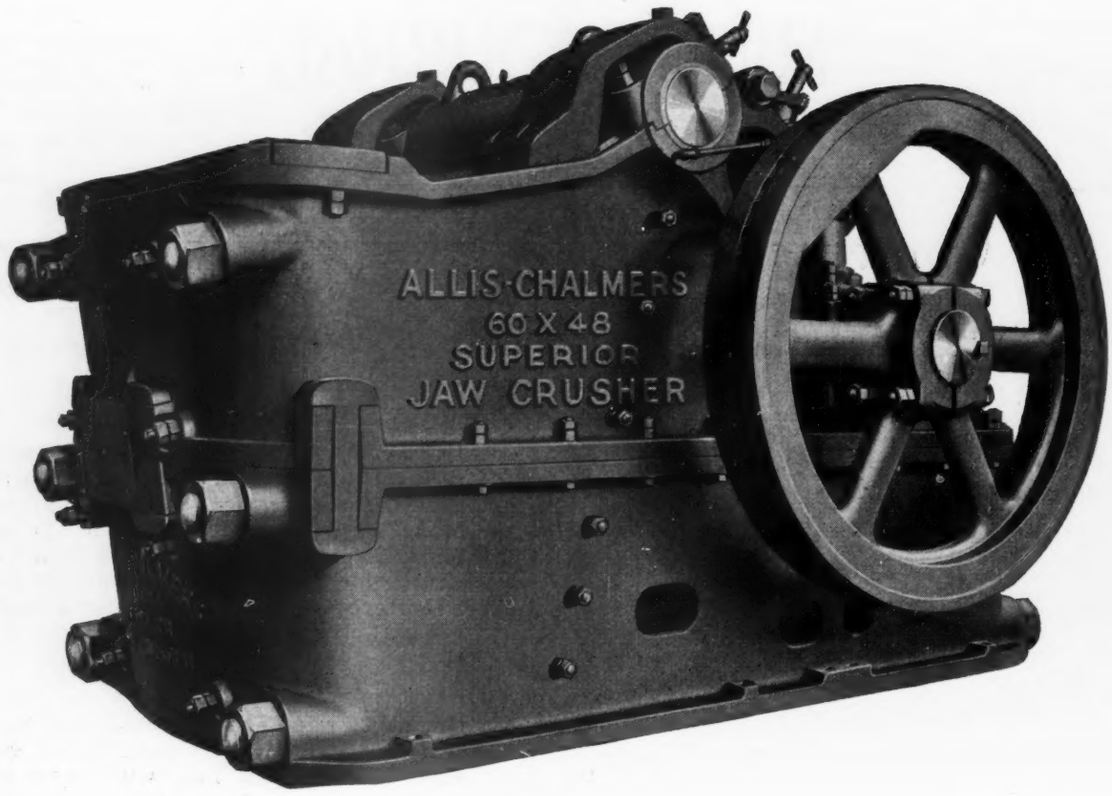


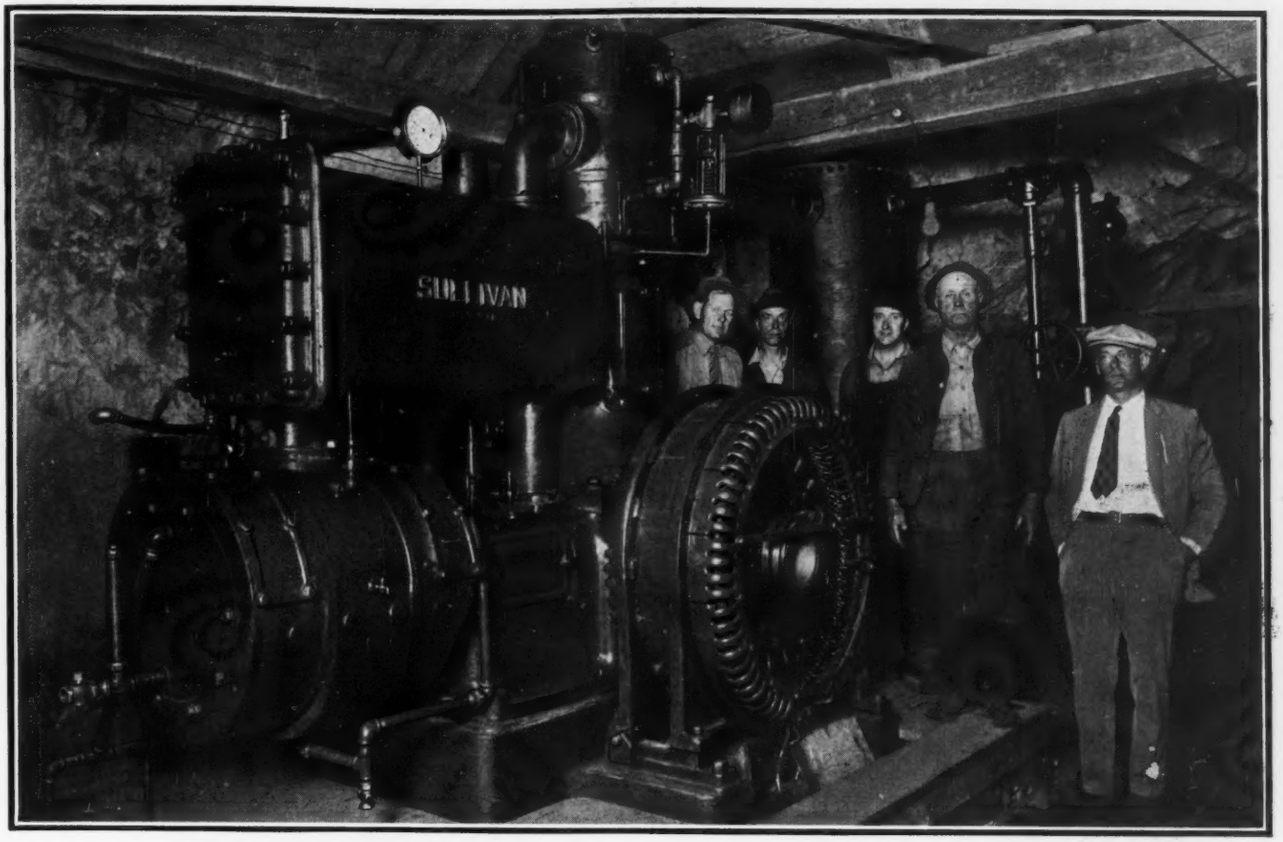
SUPERIOR JAW CRUSHERS are the result of over 50 years of crusher designing experience, combined with the most modern manufacturing facilities. The frame is semi-steel reinforced with large forged steel tension rods shrunk in place; for sizes larger than 60x48 in. the frames are cast steel and tension rods are optional, depending on the service. The success of this tension rod construction is evidenced by the fact that no Superior Jaw Crusher Frame of this construction with the rods shrunk in place has failed. Pitmans and swing jaws are cast steel in all sizes. Jaw plates are reversible. Lubrication has received the most careful consideration. This rugged construction has resulted in low operating costs even under the most severe operating conditions. Superior Jaw Crushers are built in various sizes, 15x10 in. to 84x66 in.

Write for Bulletin 1827

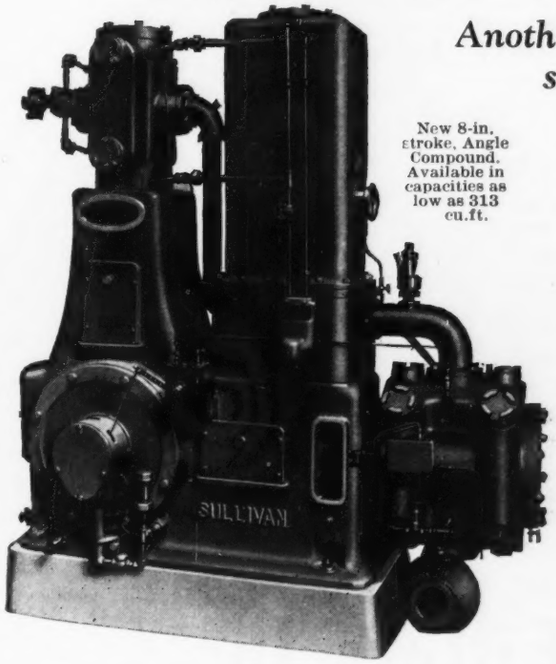
ALLIS-CHALMERS

MILWAUKEE, WIS. U. S. A.

DEPEND ON SULLIVAN AIR POWER



13,000 Feet Underground



New 8-in. stroke, Angle Compound. Available in capacities as low as 313 cu.ft.

Another Automatic Angle Compound Compressor supplies dependable air power at Lark, Utah

Here's the Sullivan "WN-31", 16-9¾x10 "Angle Compound" Compressor used by the Bingham Mines Company, at Lark, Utah, in a station 13,000 ft. from the outside.

It has full automatic electric control, and supplies dependable air power day in and day out with almost no attention. It's cheaper to string wires than to lay pipe, and the dependability of Angle Compound Compressors underground, is a big asset. Note the compactness of the installation—how the motor is mounted on the compressor shaft, with small foundations for compressor and motor.

"Angle Compounds" have always been favorites in the Intermountain District, (Utah, Southern Idaho, Eastern Nevada). "Angle Compounds" at Park Utah Consolidated Mining Company, Silver King Coalition Mines, Tintic Standard Mining Company, and four other mining companies in the territory (10 units in all) have given a total of 93 years service, and all are going strong today.

"Angle Compound" dependability, and "Angle Compound" economy, are now available for requirements as low as 313 cu.ft. per min., or as high as 5100.

Write for the Catalog 283-J

S U L L TRADE MARK I V A N

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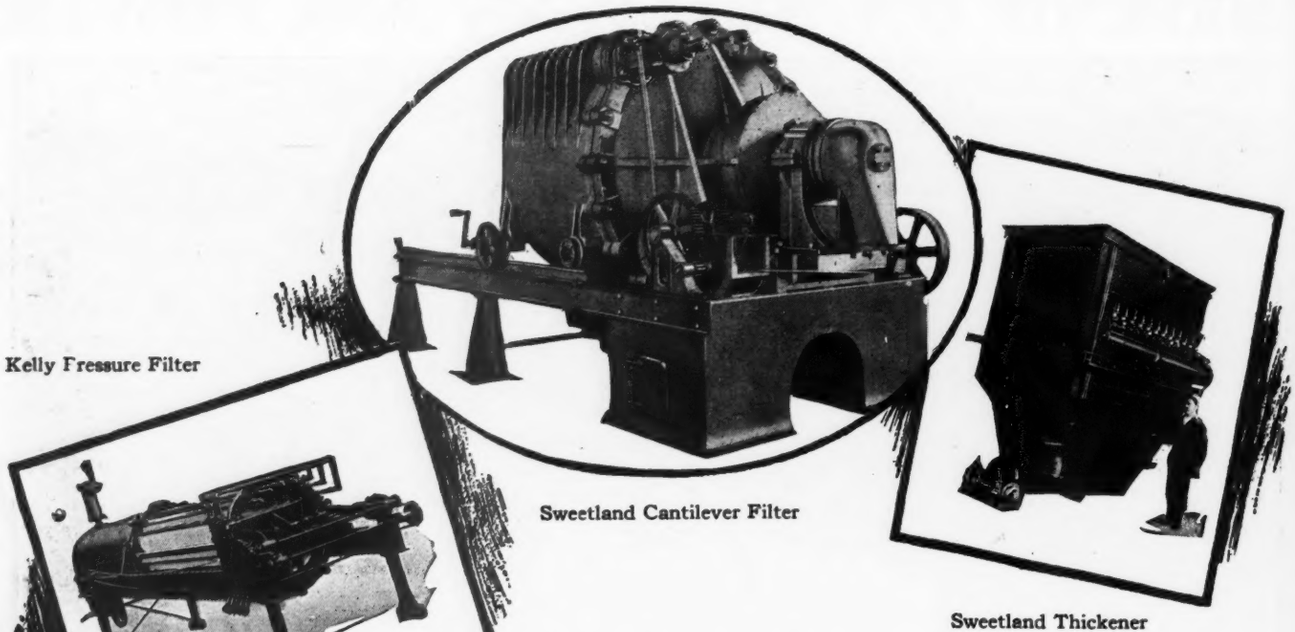
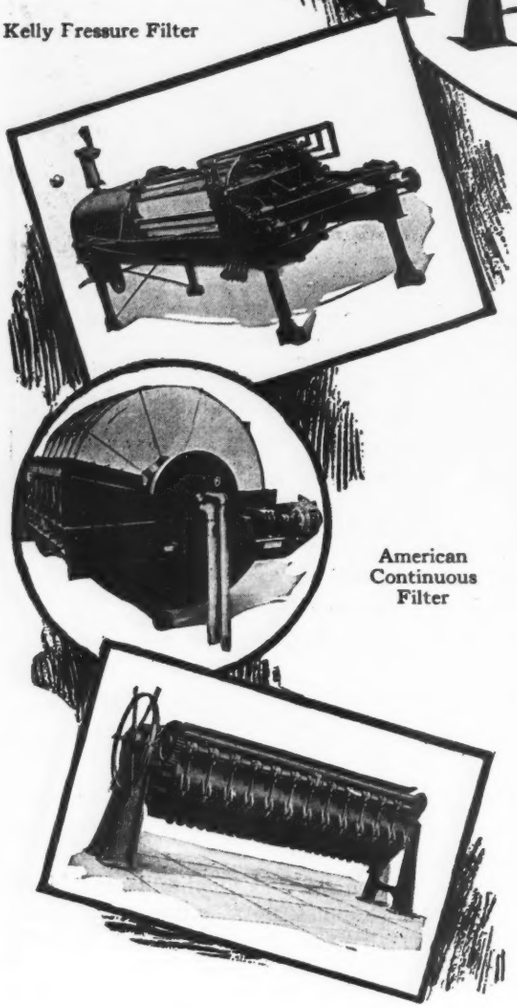


Kelly Fressure Filter

Sweetland Cantilever Filter

Sweetland Thickener



American Continuous Filter

Sweetland Pressure Filter

United Plate & Frame Press

Just to Indicate The Broad Character of United Filters Service

MINING men, of course, know the American Continuous Filter—the sectored-disc type of filter so widely used on concentrates and slimes.

But, as a matter of significance, United Filters also makes several other different types of filters in wide use in the basic industries. For example:

Sugar
- ....Sweetland Pressure Filter
- ....Sweetland Thickener
- ....Sweetland Cantilever Filter
- ....Kelly Pressure Filter
- ....American Continuous Filter
- ....United Filter Press

Paper and Pulp
- ....American Pulp Type Continuous Filter
- ....Kelly Pressure Filter
- ....Sweetland Pressure Filter

Oil
- ....Sweetland Pressure Filter
- ....Kelly Pressure Filter

Cement
- ....American Continuous Filter

Chemicals
- ....Sweetland Pressure Filter
- ....Kelly Pressure Filter
- ....American Continuous Filter
- ....United Filter Press

Industrial Products
- ....Sweetland Pressure Filter
- ....Kelly Pressure Filter
- ....American Continuous Filter
- ....United Filter Press

This broad activity assures mining men that when they come to United Filters for filters they come to "filtration headquarters".

Oliver United Filters Inc.

Successor to Oliver Continuous Filter Co. and United Filters Corp.

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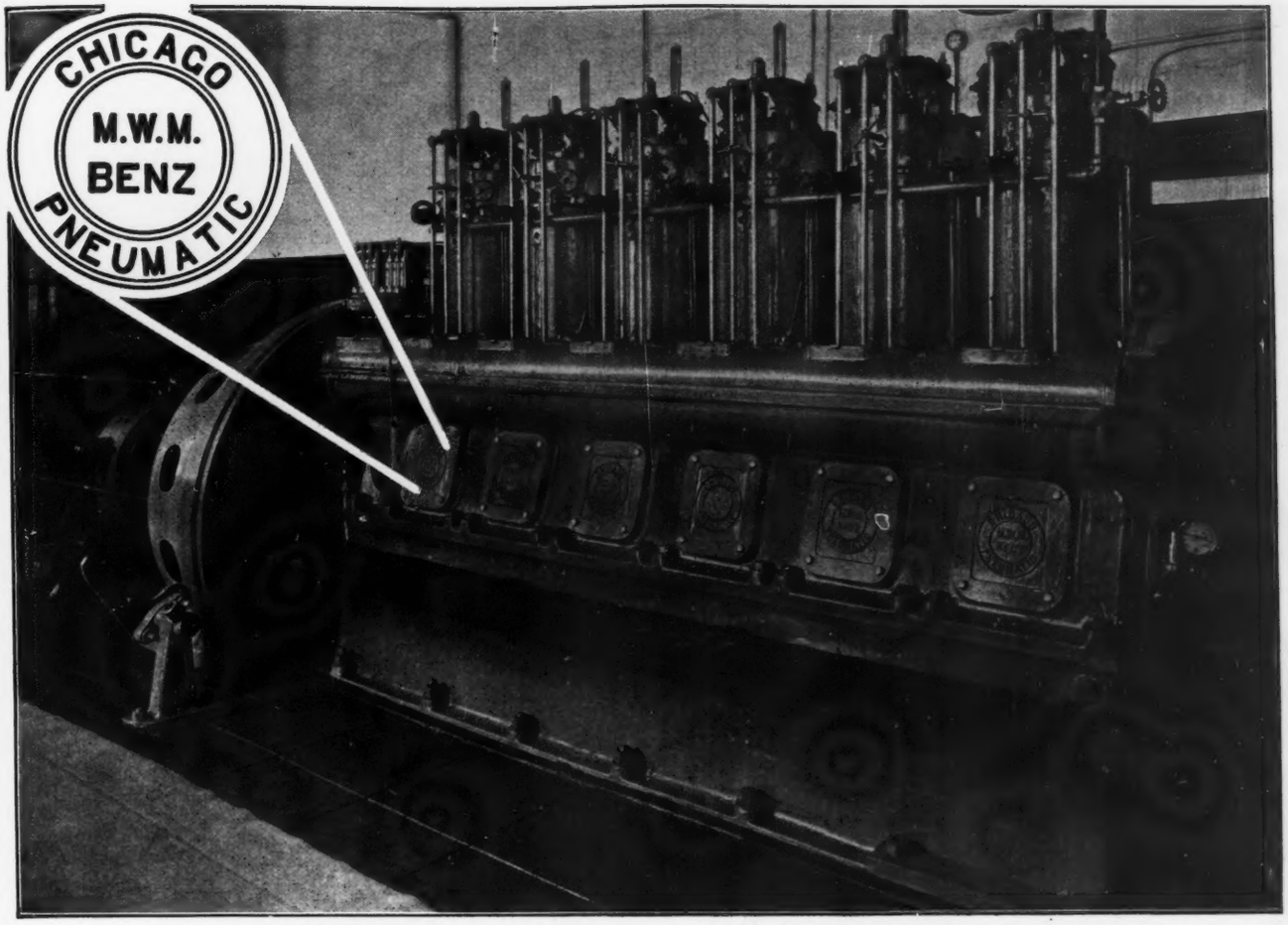

(240 H.P. CP Diesel Engine Installed by Vulcan Rail & Construction Co., Maspeth, N. Y.)

Complete Combustion

Achieved By A Time-Tested Principle That Has Never Been Equalled

NO OTHER Diesel engines in America employ the efficient combustion principle of the CP (M. W. M. Benz) Diesels. Throughout the world the Benz unique principle of differential compression pressures has proved superior for years. It effects progressive burning, rather than a violent explosion. In the pre-combustion chamber, where the fuel is injected and thoroughly mixed because of the turbulencee set up by the changing pressures, the fuel is converted into a combustible oil gas and burning begins. As pressure rises, this oil gas is forced through communicating ports into the cylinder where complete combustion occurs and continues at a progressive rate. Practically no raw fuel reaches the cylinder and carbonizing of valves is almost entirely eliminated.

Consequently, the high fuel economy obtained and the moderately high compression used, assures reliable operation at all loads and enables quick starting from a cold condition.

CP Diesel Engines are proving their superiority in numerous industrial plants and mines, as evidenced by quotations from recent letters, such as: "We can generate power at less than one cent a kilowatt" and "Our power is costing us around one cent per kilowatt."

If you are looking for dependable, economical power, let us send you illustrated and descriptive bulletins of CP Diesel Engines.

Chicago Pneumatic Tool Co.

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6 East 44th St., New York

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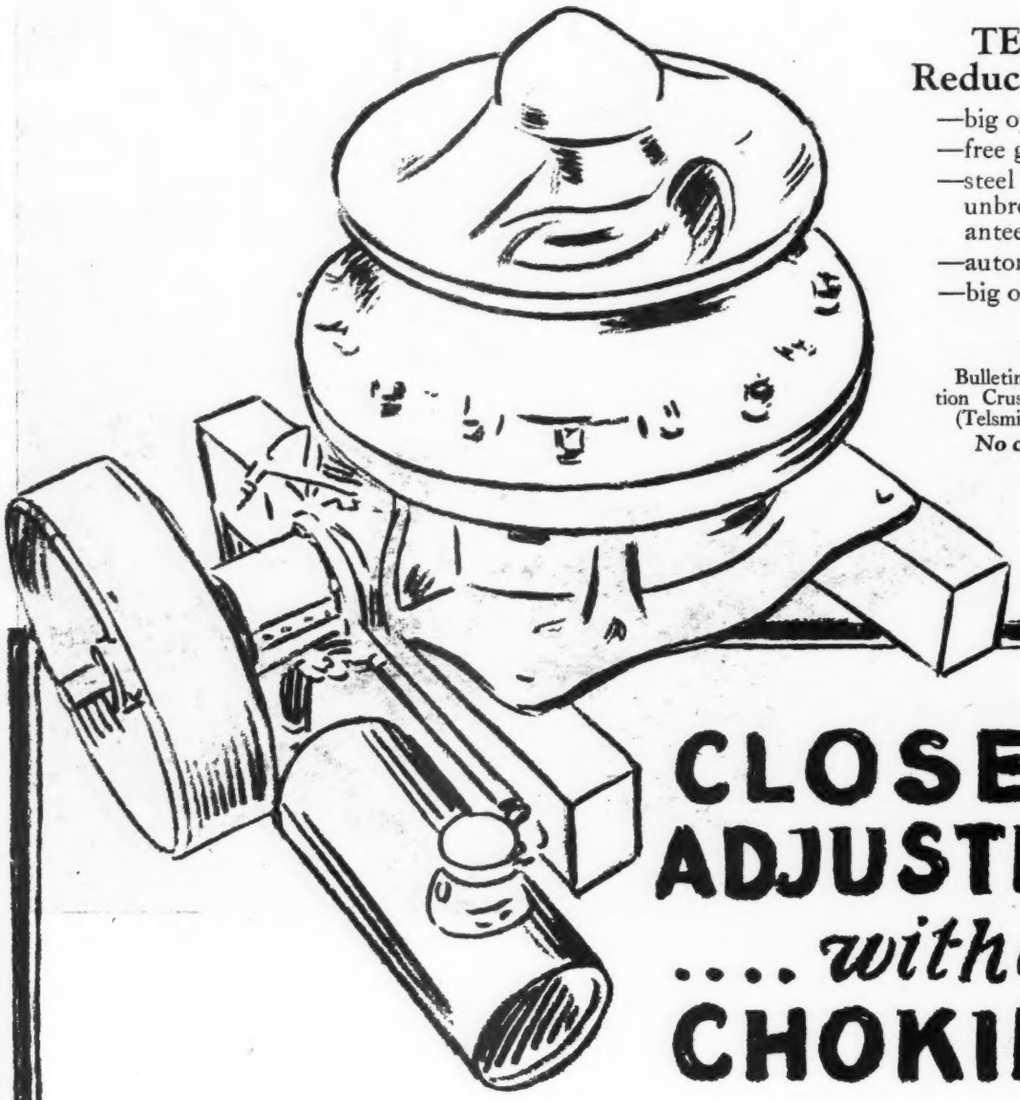

TELSMITH
Reduction Crusher

—big open hopper.
—free gravity discharge.
—steel frame and crown—unbreakable shaft, guaranteed against breakage.
—automatic lubrication.
—big oil reserve.

Write for

Bulletin 2F1 (Telsmith Reduction Crusher) and Catalog 168 (Telsmith Primary Breaker.)
No cost or obligation.

CLOSE ADJUSTMENT .... *without* CHOKING

Pile on the rock—ten feet high—Telsmith can't choke with a clean feed free from fines. There's a big open feed hopper—plenty of room for big chunks—a free vertical gravity feed.

Telsmith's head and concaves are *flared outward* at the bottom to give it an enormous discharge diameter. That's why it's an honest-to-gosh reduction crusher. A restricted discharge opening is necessary, of course, for secondary crushing; but Telsmith's discharge circumference is increased so that the bowl clears freely.

And then there's a massive steel structure and a short, rigid unbreakable shaft...You need STRENGTH in secondary crushing. The Telsmith Reduction Crusher has it.

SMITH ENGINEERING WORKS, 84 Capitol Drive, MILWAUKEE, WIS.

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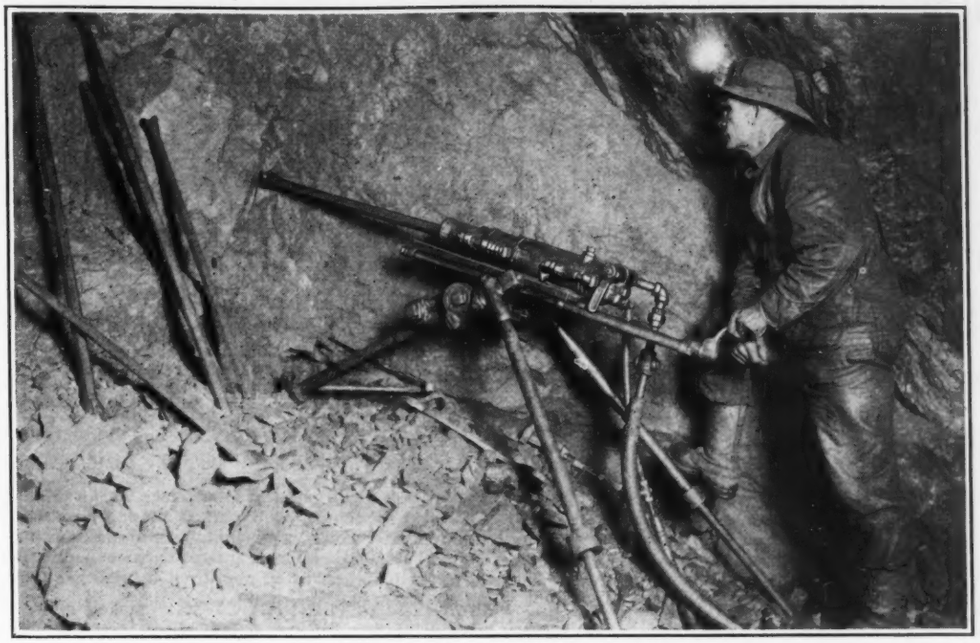
General Agents for Western States:	Mine & Smelter Supply Co.	Denver, Salt Lake, El Paso.

TELSMITH

R-1

Two Fisted! That's The NEW Cleveland D8



Cleveland D8 Drifter in a Michigan Iron Mine

Our answer to the demand for a hard-hitting one-man drifter to work in any kind of ground, is the light, sturdy *new* Cleveland D8. Try it.

Projections that might interfere with pulling steels are eliminated by the stream-line design.

Regardless of ground the new blowing device, controlled by the throttle lever, completely cleans the hole. Aided by powerful rotation it does away with stuck steels.

Positive cushions in cylinder ends preclude serious vibration. Breakage and wear is minimized. Action is unusually smooth. Guideways, being an integral part of the cylinder, are hardened for long wear. Lubrication is ample and a special taper thread combination prevents the oil plug from getting lost.

These features and many other improvements, contribute to the speed, economy and two-fisted punch that you've dreamed a drifter should have.

Bulletin 81 tells the story. But let us show you, on any two-man machine job you choose, what the *new* one-man Cleveland D8 can do.

We'll come at your convenience. Write.

THE CLEVELAND ROCK DRILL CO., 3734 E. 78th St., Cleveland, O.

Branches, Agents and Service Stations in Principal Cities and Mining Centers of the World.

CLEVELAND ROCK DRILLS

WHY TIMKENS SWEEP ON

THE WAY in which Timken Bearings have swept into dominance in so many types of industrial equipment has become the talk of all Industry. So radically and so rapidly have previous ideas of bearing performance been revolutionized by Timken Tapered Roller Bearings that the mechanical reasons which made this performance possible are sometimes lost sight of:

RADIAL LOADS AND THRUST LOADS Because of their tapered construction, Timken Bearings carry without compromise radial loads, thrust loads, or both loads in any combination, making possible more simple, compact, effective, wear-proof, and rigid mountings.

GREATER LOAD AREA Timkens are line contact bearings. Size for size, they have a greater capacity because the loads are distributed on the entire length of the rolls, cup and cone, instead of being concentrated on a very small area.

POSITIVELY ALIGNED ROLLS The design of the Timken Bearing provides for full contact along the entire length of the roll, cone and cup. The rolls are positively aligned to the axis of the cone and cup, thus allowing the bearing to function continuously at its full extra capacity.

WEAR-PROOF The longer life of Timken Bearings and their greater resistance to wear is made possible because the loads are distributed over the entire length of the rolls, cone and cup; because of the fact that radial, thrust and combination loads are provided for; because of the special analysis electric furnace Timken steel; because the parts are case hardened to give them a glass-hard outer surface with a tough elastic inner core; and because each part is made to extremely accurate dimensions. Even after hundreds of millions of revolutions, wear in a Timken Bearing is so slight as to be practically imperceptible even when measured by delicate instruments.

A PRECISION PRODUCT So accurately and precisely made is the Timken Bearing that it has become the universal standard on machine tool spindles, where a few years ago such accuracy was thought beyond attainment.

FRICTIONLESS The Timken Bearing is practically 100% frictionless: The higher load capacity and greater wear resistance of tapered line contact are thus obtained at an insignificant power loss almost impossible to calculate.

TAKE-UP IN ASSEMBLY The take-up feature in the Timken Bearing is a great advantage in assembly. Manufacturers find this to be of tremendous benefit, as it allows for minor machine irregularities, the locating of gears, etc. Last but not least, since slight wear is inevitable in any machine that revolves—(regardless of any statements to the contrary)—the Timken Bearing is designed for this take-up without affecting the proper operation of the bearing.

Revolutionizing operating and maintenance costs and stepping up production, they have brought a new day of manufacturing economies. Machine performance, never before thought possible, is now an accomplished fact. Timken dominance was inevitable. Timkens are sweeping on—wherever wheels and shafts turn.

TIMKEN *Tapered Roller* **BEARINGS**

DEMAG

Life and health are the choicest blessings of the miner. Do you think about this?

IT IS your duty to protect them by employing exclusively tools and machines that are absolutely safe. *Compressed air does not ignite fire-damp.* Therefore only employ

Compressed Air Locomotives

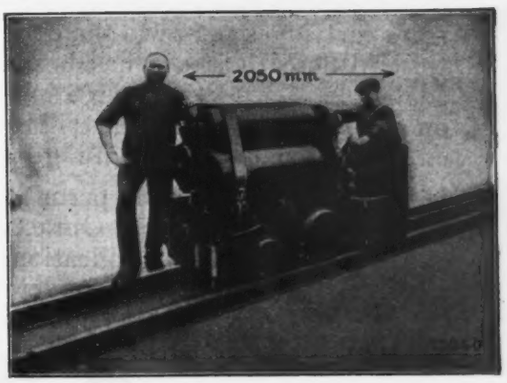
We deliver such for pit and overday-work, the consumption of air being most economical at a maximum hauling force for short and long travels. Our smallest locomotive measures only 2050 mm at a weight of 2 t. For producing the compressed air, we supply

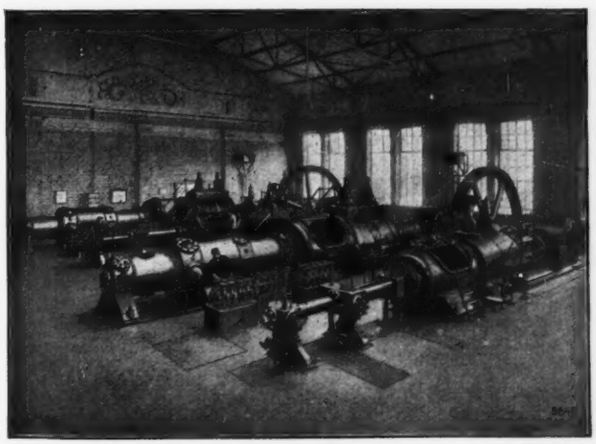
High Pressure Compressors

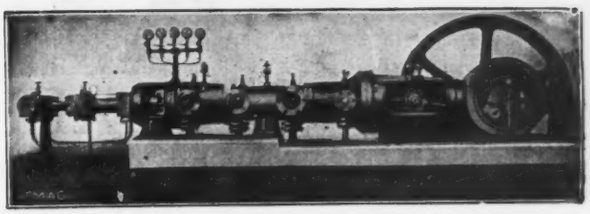
which have been highly approved of in numerous designs. Besides many mining companies, laboratories and chemical factories have been supplied with high-pressure compressors,

rendering 300 atm. pressure and more.

Circulars and estimates will be submitted free of charge and without engagement.







DUISBURG

Germany

Relief from expensive GELATINS!

RELIEF from the use of expensive gelatins is dependent on the character of the ventilation and drainage of your mine and the pitch of your bore holes.

There is no positive relief if the ventilation and drainage are poor and if the bore holes pitch steeply upward.

The good fumes, water resistance and plasticity of the Gelatins, which these conditions demand, are not possessed by any other type of industrial explosives — nor can there be any substitution for them.

If your mine is well-ventilated and drained, and the bore holes are not steeper than 45°, or if you are content to use clay stemming in the steeply-inclined bore holes, use of our APCODYNS will affect worthwhile economies in blasting costs.

The APCODYNS of varying strengths and velocities will run 40 to 50 per cent *more* cartridges per cwt. than the gelatins. Where their use has been found adaptable, the APCODYNS have shot on approximately a cartridge-for-cartridge basis with the gelatins.

If you feel conditions will permit their use, we suggest you give the APCODYNS a trial. Our experts, who have had extensive experience in their application, are available always for any help you may need in determining the adaptability of the APCODYNS to the job you have in mind.

ATLAS
EXPLOSIVES
ATLAS POWDER COMPANY

A proper explosive for every blasting requirement

WILMINGTON, DELAWARE

Branch Offices:

Allentown, Pa.; Birmingham, Ala.; Boston, Mass.; Charleston, W. Va.; Chicago, Ill.; Des Moines, Iowa; Houghton, Mich.; Joplin, Mo.; Kansas City, Mo.; Knoxville, Tenn.;

ATLAS EXPLOSIVES

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Grout Pipes at Texas Salt Company Shaft

Grouting to Control Excessive Water Flow

At 138 feet in depth, sinking of the Texas Salt Company's shaft had been abandoned because of excessive water flow. The problem of continuing the shaft to rock salt was turned over to Longyear engineers. Preliminary diamond core drilling was done in and around the shaft by Longyear crews and these tests showed a broken and water-bearing cap rock above the rock salt. It was at once apparent that the water flow must be shut off by grouting before sinking could be resumed.

With the shaft 138 feet deep and concrete-lined to the bottom, 35 holes were drilled from surface, fifteen feet outside the shaft wall and approximately six feet apart, to the top of the salt at 250 feet. Six thousand three hundred and eighty bags of Portland cement were forced into these grout holes under pressure up to 300 pounds a square inch. A drill hole at the shaft bottom which had been making 150 gallons of water a minute was dried to a trickle and later sealed by direct grouting with less than a bag of cement. Supplementary grouting from inside the shaft through rock drill holes preceded excavation and Longyear crews advanced the shaft through the water-bearing area with a maximum water flow of 25 gallons a minute. Progress was not rapid but it was continuous. The water situation at all times was under perfect control and the shaft is now advancing satisfactorily.

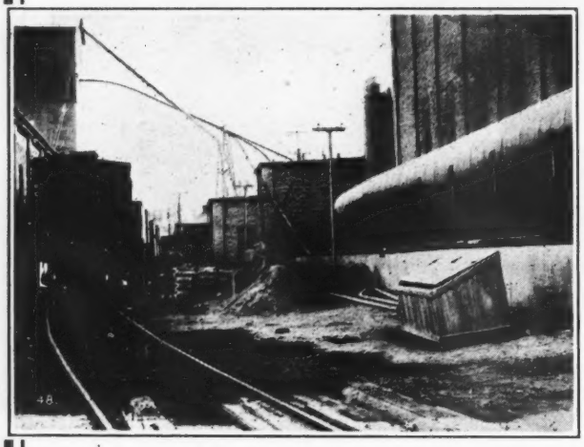
Longyear activities include shaft sinking, mine development and diamond core drilling. We shall be glad to have you consult us about your prospective work.

E. J. Longyear Company

Minneapolis, Minnesota, U.S.A.

HANDLING FLUE DUST

Respirators, safety goggles and dust-proof clothing constitutes the costume of these men who collect the valuable flue dust in chambers provided for the purpose at smelters.



Conveying Pipes shown going to different parts of plant, and part of one line along flue.

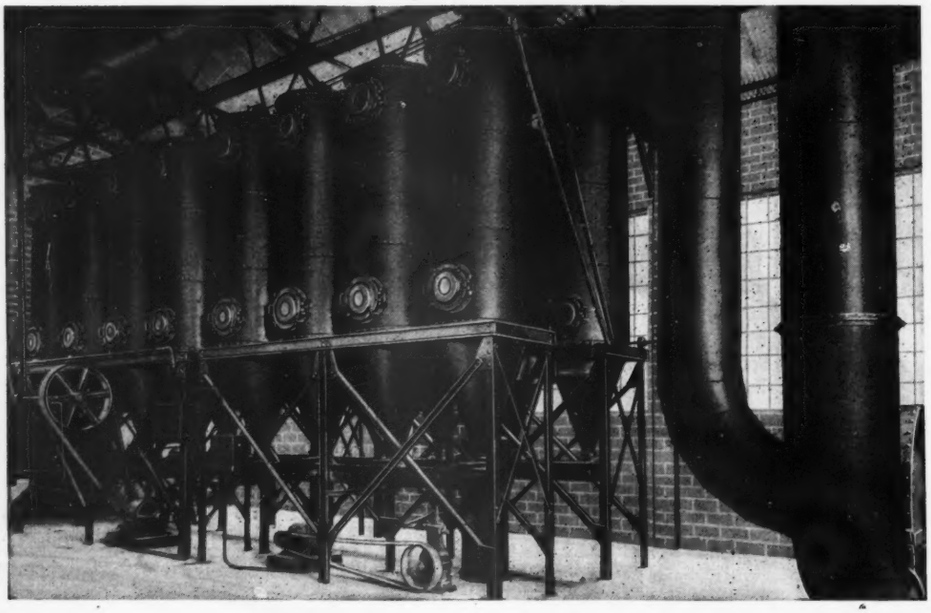
Solving a difficult labor
DRACCO—*the modern*
handling and dust

JUST a glance at the men above and you can understand why men, human beings, will not stay on a job like this. We have instances on file where plant production was actually hampered due to difficulty in finding men who would do such risky work.

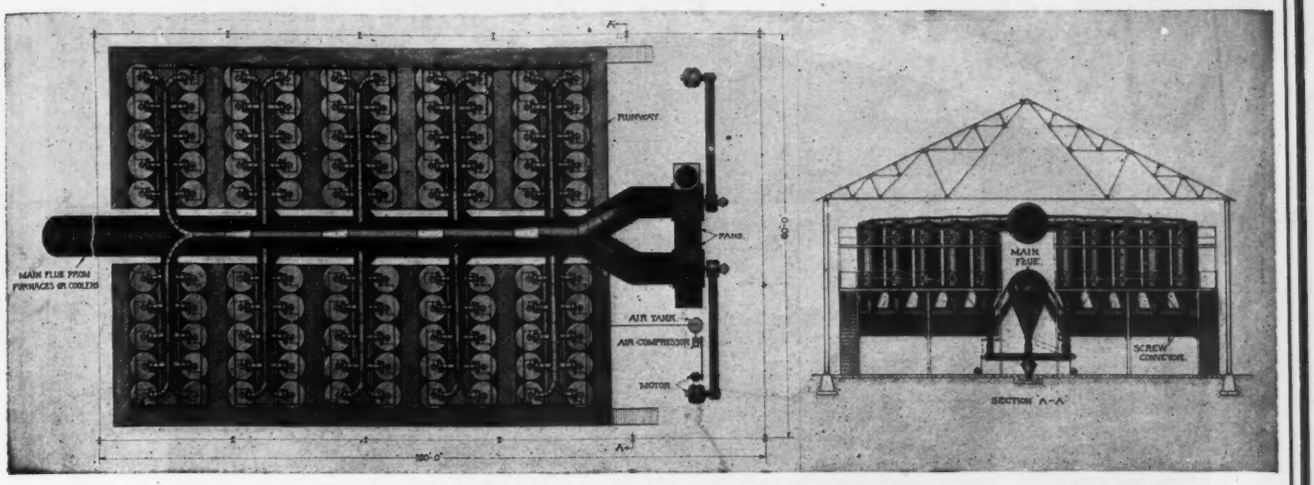
Dracco Pneumatic Conveying System eliminates this kind of work—provides a clean method of handling —uses less labor and is more economical.

The small illustration at the left center shows pipe conveying lines handling fine material the modern Dracco way. On this job "blue fume" is being handled and this concern states that before Dracco was installed, work had to stop on windy days, now plant is operated all the time regardless of weather.

Dracco will pay in your plant. Let us show you how.



Dracco Filters for handling gases and fumes automatically.



situation with *system for material recovering*

On this page we show an installation which will filter 100,000 to 125,000 cubic feet of gas per minute with a guaranteed efficiency of not less than 99½%. This is approximately 6 to 7 times as much as in the old style bag house.

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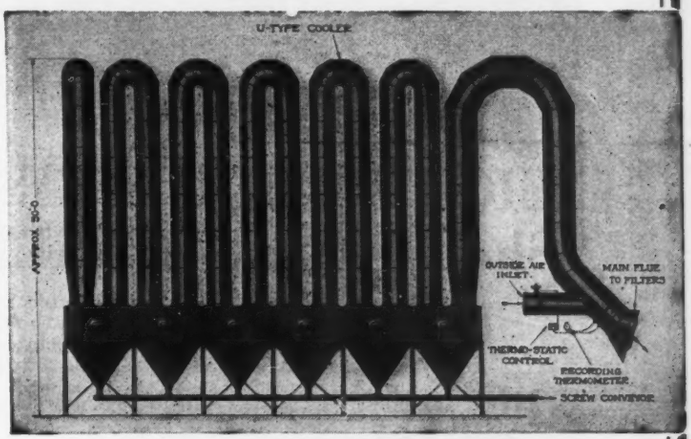
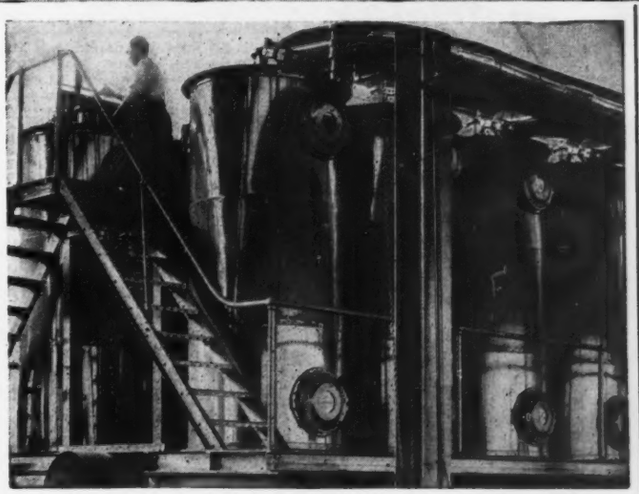
Cleveland, Ohio, U. S. A.



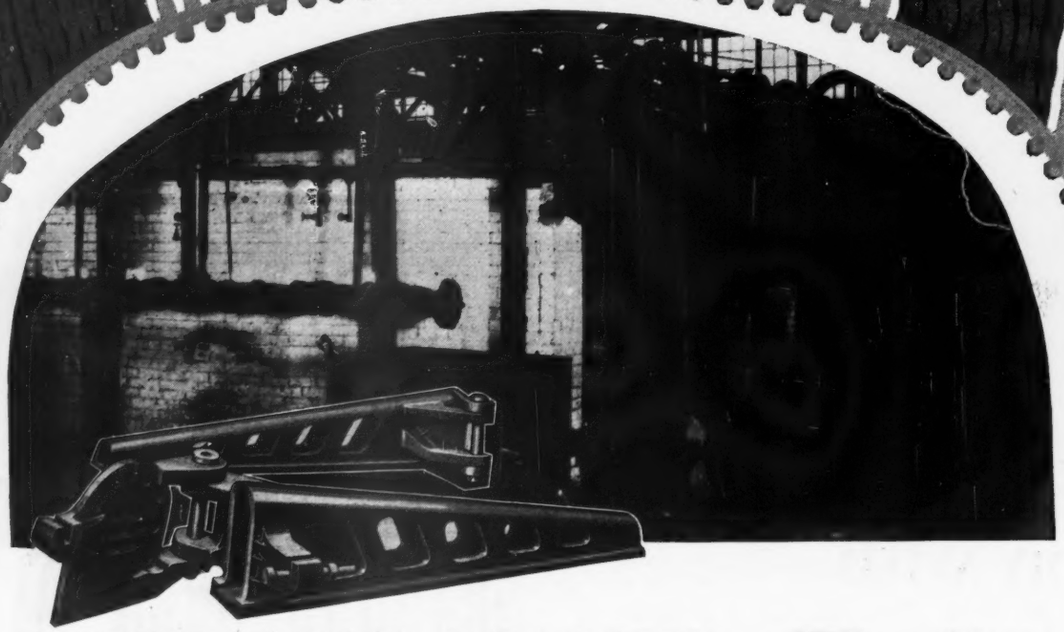


Top. **Plan and End View of Dracco Fume Recovery Plant with Ten Compartment Perfecto Filter Units.**

Center. **U Tube Dracco Cooler.**

Bottom. **One Ten Compartment Type AA Perfecto Filter.**

DRACCO DOES IT



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Park Utah Consolidated Standardizes on O-B Line Material

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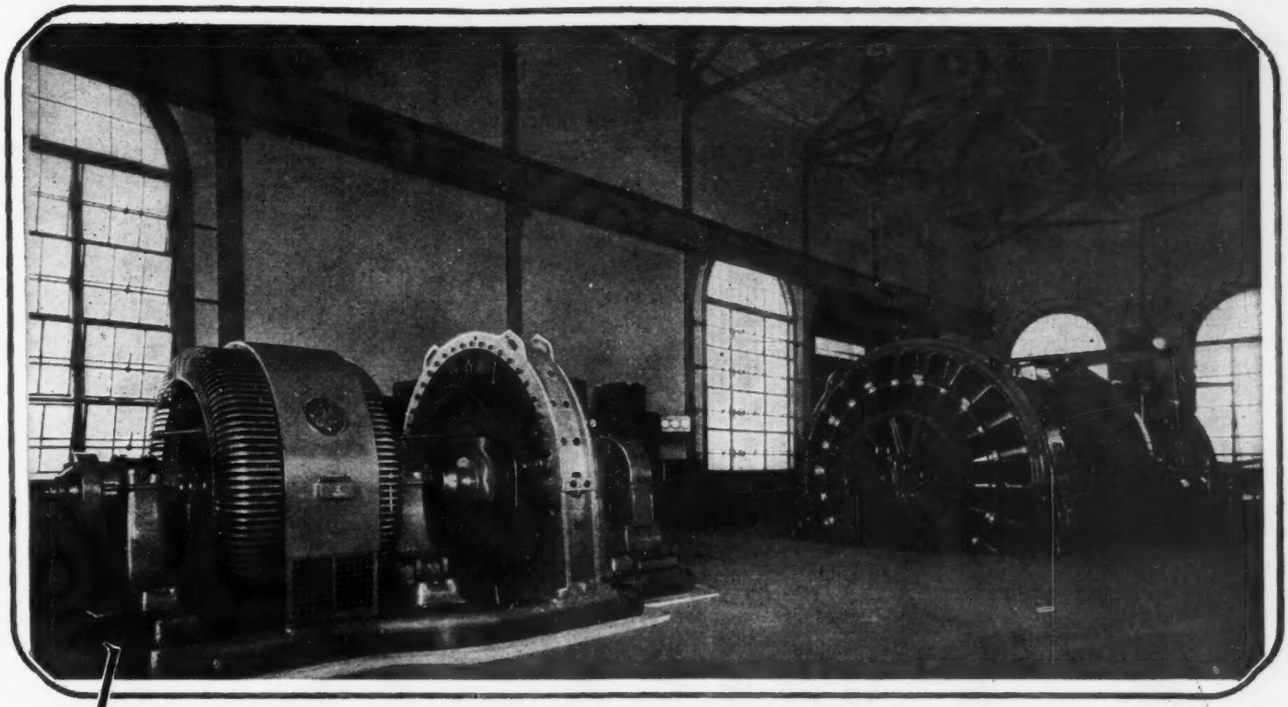

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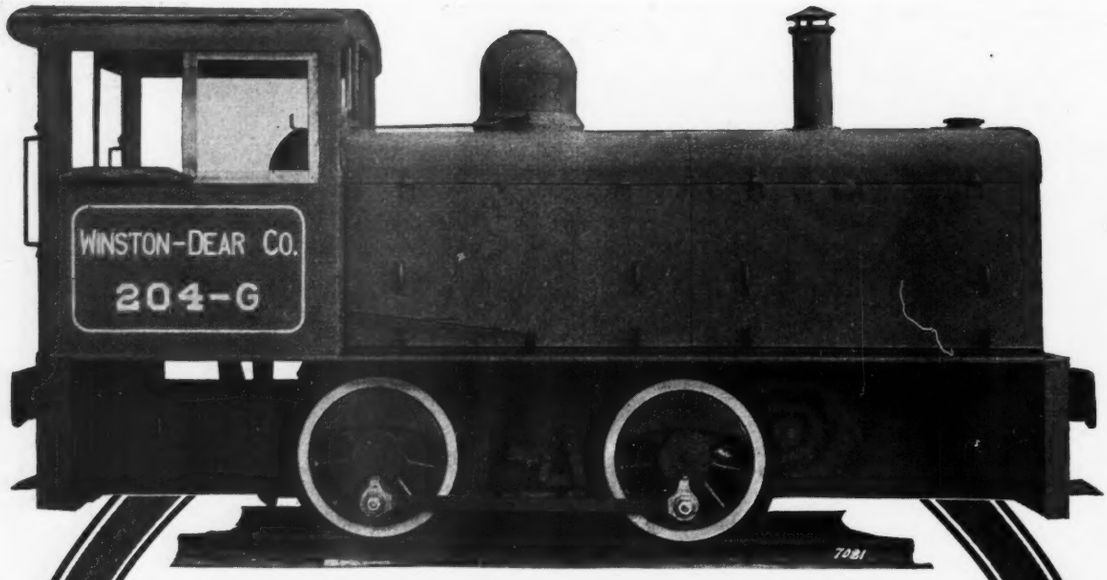

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ENGINEERING AND
MINING JOURNAL

McGraw-Hill Publishing Company, Inc.
JAMES H. MCGRAW, *President*

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Editor

VOLUME 126 — *New York, July 21, 1928* — NUMBER 3

Purpose and Craftsmanship Rather Than Mere Performance

IN A RECENT EDITORIAL commenting on the value of engineering methods in business and government, *Engineering and Mining Journal* showed a frank partiality in favor of Mr. Hoover. The prospect of government under the orderly influence of scientific method is an alluring one, especially when it is admitted on all sides that the man at the helm has behind him a broad experience in humanitarian as well as in technical enterprise.

The use of the words "engineering," "scientific," and "technical" reminds one of a recent definition of "engineering" submitted by Dean Probert of California University—that it is "the skillful use of scientific knowledge contributing in any way to technical enterprise." In explanation he added that "by 'skillful use' is meant that there is an organized, systematic, competent plan of action, involving ingenuity and understanding, not intuition or instinct: a purpose, application, and the faculties for execution; 'of scientific knowledge'—this covers both pure and applied science, mastery of principle and practices; 'contributing in any way'—in whole or in part, the influence of any factor, human or inanimate, any and all steps toward the solution of the project; 'to technical enterprise'—the adjective is restrictive, eliminating many highly scientific fields of endeavor; and the word 'enterprise' is chosen, rather than 'business' or 'industry,' because many engineering undertakings or projects, involving great resource, energy, perseverance, are often but a part of the large field of business organizations or industrial systems, conducted for profit or gain."

Dean Probert's conclusions offer food for thought, as does the entire address on "Science, Engineering and Industry," delivered at the University of Utah recently, from which the definition is taken. Many doubt the value of a discussion that seems to lead nowhere, but the opinions expressed in recent years as to what is an engineer and what is engineering have been productive of at least one important result: a departure from the formula proposed by the civil engineers, that an engineer is a quixotic and altruistic individual whose main characteristic is an ability to utilize the forces and materials of nature for the benefit of mankind. What was probably the first evidence of disagreement with this idea appeared in this journal ten years ago, and a substitute definition was based on the derivation of the word "engineer," which Webster defines as "(O.F. *engignier, engigneor*)—One who designs or contrives; an inventor." It was proposed, therefore, that an engineer is "A technician who applies creative effort to the solution of a problem or to the operation of an enterprise."

In course of time a switch was made from the concrete to the abstract—to the consideration of "engineering" rather than "the engineer." This takes the matter outside the human field, and one may well consider that the construction of a spider's web or a coral atoll is perhaps as much an engineering feat as the building of a bridge or a skyscraper. The object and purpose in each instance may not be so far apart as one might first imagine. The coral insect may erect a monument several miles high, stopping only when conditions inhibit existence of the "engineers." An attempt to climb Mount Everest may be foiled because conditions at great altitudes are equally fatal to human beings.

Dean Probert limits "engineering" to "technical enterprise, to exclude many highly scientific fields of endeavor." To switch back from the abstract to the concrete—to make the study easier—the early definition claimed that an engineer is a technician, which prompts a brief excursion into accepted interpretation. "Technical," according to Webster, is "of or pertaining to the useful or mechanical arts, or any science, business, or the like." This breadth of scope is confusing, so in search of a narrower interpretation one may turn to the Greek, to find that τεχνιτης means "craftsman."

Craftsmanship implies much more than performance, even skilled performance. The word suggests recognition of a personal code that goes beyond instructions or acquired knowledge or formulas. It connotes standards, principles, and a high purpose in execution—almost an idealism—that insures an uncommon distinctiveness in result. It is this characteristic that underlies the best conception we have of the real engineer, as distinct from the point of view that he may merely engage in routine performance. If one accepts the contention that his underlying trait is adherence to a code that puts principles and purpose in the forefront, and that strives for result by the utilization of inventive and creative skill, it will be apparent why the engineer is "finding himself" in almost every branch of human activity.

All Europe Now on a Gold Basis

WITH the stabilization of the French franc at about 3.93 cents, the last European country of importance has returned to the gold basis, and the fears expressed in some quarters that gold would lose its old prestige have pretty well evaporated. In fact, the recent action of the French government is said to be the first instance in French history that all traces of bimetalism have been frankly abandoned. A minimum of 35 per cent of gold reserve is to be maintained against the note circulation of the Bank of France. In preparation for the stabilization, more than two hundred million dollars in gold has been recently exported from the United States to France.

Gold is the one thing that can be put away in the teapot or the old stocking with no fear that its value will

seriously decline. The word seriously is used advisedly, for of course as price levels go down or up, gold becomes more or less valuable, and the gold producer or hoarder is more or less prosperous accordingly. Holders of silver are less fortunate, though the situation is not so bad as press reports from France have indicated. For example, headlines in last week's newspapers suggested the loss sustained by French peasants, who, instead of putting their money in the bank, had hoarded silver coins since before the war, and who were now able to cash them only at their bullion value. Had they put their money in the bank, they would have received only a paper credit, and instead of getting about 40 per cent of their savings back, as they do in turning in their silver, would have had only about 20 per cent, which is the relation of the new French franc to the old.

Simple Determination of Classifier Efficiency

THE function of a classifier is to divide a flowing pulp into two or more products, at a predetermined mesh or at predetermined meshes. Long after the importance of efficient classification was realized, screen analyses were considered as an index of performance. These, of course, gave percentages of the sizes in the feed and the various products, from which proportionate weights could be determined: but they were difficult to interpret, and in 1917 it was suggested that the efficiency of classification might be considered as that proportion of original feed deflected into the desired channels.

A logical objection was raised to this proposal, in that the use of the formula would show positive efficiency when a mere division of the original feed occurred, necessitating adjustment by a factor to insure consistent results. Mr. R. T. Hancock (1920) maintained that "the percentage of efficiency of concentration is obtained by loading the valuable mineral in the tails with so much of the waste as is required to give a product of the composition of the original feed, and dividing the balance of the waste in the tails by the total waste in the original feed." The introduction of concentration efficiency confused the issue, but it was maintained that the Hancock formula was equally applicable for the determination of classifier efficiency.

Mr. H. A. White, in the *Journal* of the Chemical, Metallurgical and Mining Society of South Africa (1925), interpreted the Hancock theory as follows: "The original feed to the classification machine is regarded as divided into three portions, one cleanly divided into the desired products, the ratio of which to the amount of the original feed expresses the efficiency of the result, the two others of a composition identical with the feed in the underflow and overflow, respectively, their ratio to each other being immaterial."

Professor S. J. Truscott, in his "Text Book of Ore Dressing," subscribes to the Hancock theory, and interprets it thus: "When the operation results in the complete separation of the oversize into the coarse product and of the undersize into the fine product, the efficiency is 100 per cent. Intermediate results are gaged by calculating the amount of unaltered feed in the coarse product—this being done by 'loading' the undersize in that coarse product with the amount of oversize necessary to give a product of the composition of the feed—then deducting the amount of oversize in that unaltered feed from that actually present in the coarse product; the remainder, divided by total oversize in the feed, is the figure expressing the efficiency of the operation."

The equation is finally reduced by Professor Truscott to an expression indicating that percentage efficiency equals: "Bulk percentage of oversize in coarse product plus bulk percentage of undersize in fine product minus 100." This is equivalent to "That percentage of the oversize in the feed found in the coarse product, plus that percentage of the undersize in the feed found in the fine product, minus 100"; or, the percentage efficiency of the joint operation is the sum of the percentage efficiencies of each individual operation, minus 100.

Sundry variations in expression of the Hancock theory have been evolved and applied, all based on the same fundamental line of reasoning. More recently, Mr. E. G. Lawford proposed that efficiency of classifier performance could be measured by multiplying the efficiency of coarse separation by the efficiency of fine separation. This, as Prof. Charles E. Locke points out, is reminiscent of the calculation of efficiency of a steam engine-compressor unit by multiplying the efficiencies of the individual units. A distinction must be recognized, however: the classifier is performing a double function in two simultaneous phases; the operations of the engine-compressor unit are in sequence.

In response to renewed interest in this problem of the determination of classifier efficiency, several simple diagrams were drawn which indicated a wide range of variable conditions as to the proportion of coarse and fine constituents in the feed and the proportion of unwanted material in the products. The dominant reaction was that none of the formulas proposed gave results that seemed consistently logical. We are prompted, therefore, to modify the original proposal and to suggest that the efficiency of classification, at a predetermined mesh, is represented by the proportion of material deflected into the desired channels, less the proportion of undesired material that contaminates each product.

We are not inclined to admit that a solution of the problem is impossible; and it is evident that a simple "yardstick" would be of value for comparative purposes. Much may be gained by constructive comment leading to the general acceptance of some standard method of determination, which should also be applicable for the determination of screening efficiency, bearing in mind that this is affected by the condition of a sieving medium that deflects all the desired oversize into one channel only when in perfect condition.

Good Weevil Season Encourages Arsenic Producers

REPORTS from the Southern cotton districts indicate that the boll weevil activities will be much more brisk this season than last. The cotton crop is late, and the cool, wet weather has favored the growth of this destructive insect. Much depends upon the weather during the next month; if hot and dry, less damage will be done.

Prevalence of the boll weevil is always encouraging to the arsenic producers, for calcium arsenate is the chief agent used to combat the pest. If a large amount is required, the demand for arsenic should be increased, though not immediately, of course. Normally, the

amount of arsenic used on the weevil is not a large proportion of the total consumption; in 1926, for example, it was estimated that about 20 per cent of the total arsenic consumed was for calcium arsenate. Nevertheless, demand in this direction is capable of a large expansion if the insect damage threatens to become serious.

Crude arsenic production so far this year has averaged about 1,000 tons a month in the United States—approximately the same as last year, with imports also at about the same rate as a year ago. Stocks mounted a little in the first part of the year, but are not excessive. With the price continuing at four cents per pound, there is little profit in this byproduct; and producers grasp at straws, such as the weevil reports, for comfort. What is really needed is the development of a large and stable avenue of consumption such as might be offered by the development of arsenic compounds as wood preservatives.

New Investment Trust for Mining Shares

DIVERSIFICATION is a recognized requirement for sound investment. The individual whose funds are limited but who desires to invest in a mining venture is at a decided disadvantage. He can, of course, select a few well-established companies in which his capital is comparatively safe; but the return is proportionately small, and he has no opportunity to participate in large profits accruing to the sensational development of promising prospects into rich mines. He can, on the other hand, speculate in a few of the immature enterprises, but of these only a small proportion become earners of big money. Here diversification is more necessary than in any other kind of speculative investment; but more than diversification is needed. Careful engineering, financial and technical investigation will serve to eliminate a large proportion of the undertakings as too risky to warrant support. Such care will, on the other hand, detect youthful enterprises in which the possibilities are enormous. Obviously, however, the "small" investor cannot afford to have such investigations made, any more than he can include in his list stocks in companies operating in various countries, and mining a variety of metals or other mineral products.

In this connection a form of the investment trust serves a most useful purpose: through it a man can diversify his investment with respect to products, companies and localities; he can place his funds in speculative as well as in dividend-paying ventures; and he can obtain the best of expert engineering and technical guidance in selecting desirable companies.

In the summer of 1925, the Newmont Mining Corporation first offered its shares to the public, though it had been in existence as a private company sponsored by Colonel William B. Thompson for nearly ten years. Its principal assets were shares in copper, sulphur, petroleum, gold, diamond, and coal mines. The public offering was made at $46. Since then the trend of the market for the stock has been steadily upward, and recently $185 was passed. The long and persistent bull market and more or less good luck, combined with careful guidance on the part of both the engineers and the financial administrators of the company, has brought better profits than had been expected.

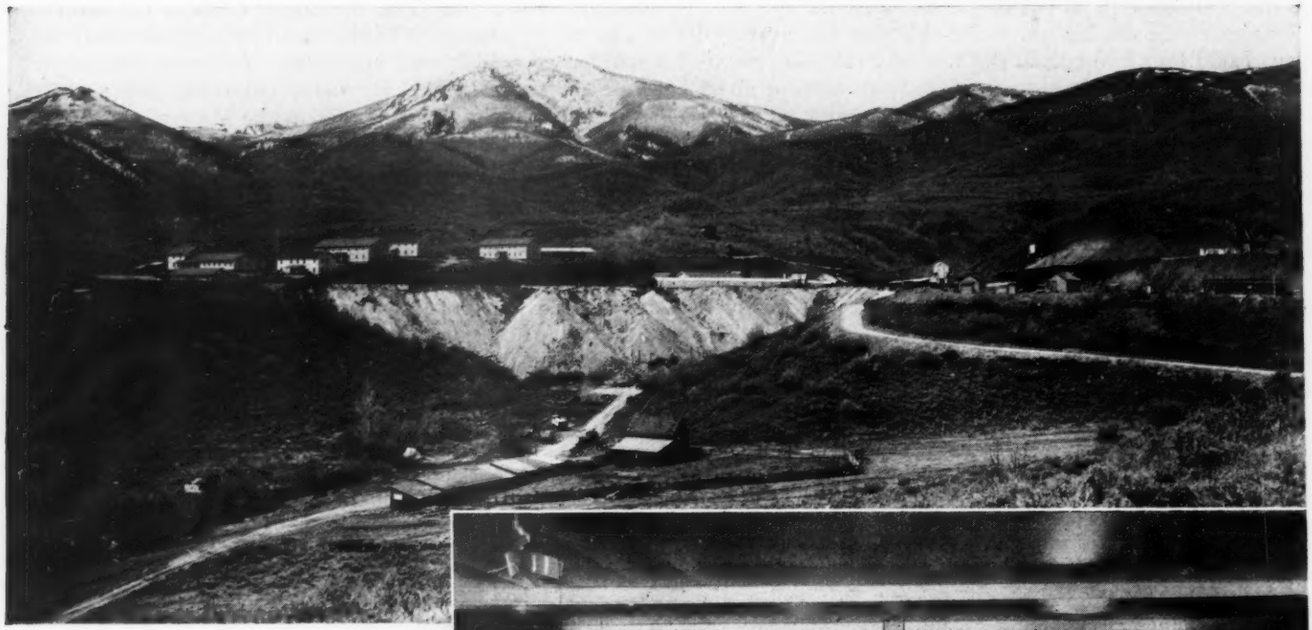
This excellent record might have been expected to induce many others to emulate Newmont. However, not until recently has this been done. On July 12 announcement was made of the initial public offering of the stock of Metals and Mining Shares, Inc., organized "to provide a medium for safe and profitable investment in the metal and mining industries of the world," to quote from the prospectus. The directorate contains the names of a group of prominent bankers and industrialists and of a number of well-known engineers. A second company, whose directors include the same engineers and a few others, and which is to be known as the Mineral Research Corporation, is to "assemble the information to guide the directors of Metal and Mining shares in the selection of investments." The Research Corporation is to receive a fixed fee in addition to remuneration on a profit-sharing basis for its services. Of the invested funds at least 70 per cent is to be placed in established dividend-paying shares; and the remainder may be used in the purchase of stocks of a purely speculative character. Various provisions in the bylaws have for their purpose the automatic diversification of investments. The present high prices of shares naturally tends to make operations in the market less promising of big profit. The plan is an elaborate one, and in theory it seems sound and logical. Success in practice will hinge in no small degree on the competence and honesty of the men who administer the affairs of the company. The personnel, as published in the prospectus, seems satisfactory.

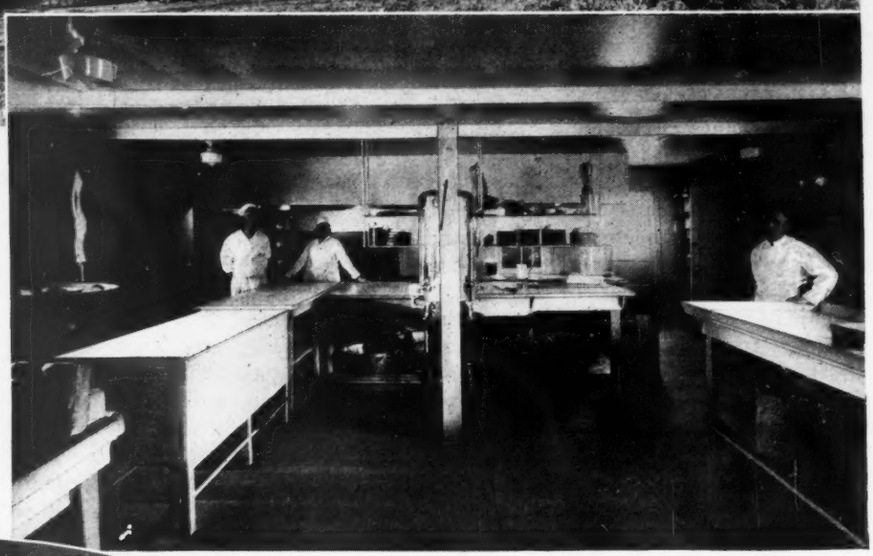
Foreign Exploitation of Soviet Manganese Fails?

AMERICAN exploitation of the natural resources of Russia has not been attempted to any large extent since the World War, and the reported unsuccessful outcome of the one important American enterprise, the Harriman venture in Georgian manganese, will not stimulate American investors to undertake further projects in the Soviet domain. Reports that the Harriman concession has been terminated cannot be verified at the head office of the company in New York, but well-informed opinion is to the effect that they are true. The Moscow version states that a loan is to be made by the Harriman interests for the further development of the mines, and that the entire investment, amounting to approximately three and a half million dollars, will be returned to Harriman by the Soviet government over a period of years. If this report is accurate, the American investors apparently will not lose anything except the opportunity for a profitable business which they expected to result when the twenty-five year contract was signed four years ago.

Rumors of dissatisfaction have been current for some time, the trouble arising from the fact that too much competition has arisen from other producers, in particular the Nicopol mines. It was thought that this was patched up last year when the minimum royalty payable by the Harriman concern to the Soviet was reduced from $3 to $1.50 per ton, and other Russian production was restricted, but apparently reason for dissatisfaction still exists. Information is lacking as to whether the Soviet government has not played fair or whether the fault lay in a lack of astuteness and understanding of conditions on the part of the Americans. But whatever the reason, it is unfortunate that this mining project has not had a more successful outcome, for Russia sorely needs foreign capital to develop her natural resources.

AN ELECTRIFIED KITCHEN IN A





Above—General view of the surface plant of the Park Utah company at Keetley, in the Park City district

Above—The chef and his two assistants in the "electrified" kitchen. Left—View of the kitchen showing the electric coffee urn in the center

MODEL MINE BOARDING HOUSE

This light and airy dining room, with a capacity of serving 260 men, is an improvement on the average mine boarding house of ten years ago

PREPARING meals for underground miners in a roomy, well-lighted, sanitary kitchen, provided throughout with electrical cooking equipment, is not a usual practice. Among the properties that may boast of an electrified kitchen and a model mine boarding-house is the "Utah" unit of the Park Utah Consolidated Mining Company, situated in the Park City district in Utah.

In keeping with the company's policy of using electric power wherever possible, the kitchen and dining room of the boarding-house are electrified throughout. They are, besides, spotlessly clean and well lighted; and the chef and his two assistants wear immaculate white duck. The building, with its modern features and efficient management, may well be referred to as a model.

Electrical equipment in the kitchen includes a 10-gal. Edison coffee urn; one 4-ft. Edison heavy-duty range with a 4-ft. cooking top; an Edison heavy-duty service griddle; one two-deck baking and roasting oven; and one three-deck baking oven. These separate units, with the exception of the urn, have been placed side by side along one end of the kitchen, as shown in the accompanying illustrations. Over these units is a hood that is ventilated by a fan, the capacity of which is sufficient to change the air in both the kitchen and dining room in three minutes. The total connected load in the cooking equipment is 71.8 kw.

The kitchen and dining room are arranged to prepare and serve three meals a day to 260 men. Power consumption of the electrical cooking units is estimated at 6,000 kw.-hr. a month, as against $70 to $100 worth of coal required with coal-burning units, formerly used. A direct as well as an indirect saving is effected.

Electrical cooking units, including ranges and ovens. They are more economical than coal fires

Mining Ore by Top Slicing

By CHARLES A. MITKE
Consulting Mining Engineer, Phoenix, Ariz.

TOP SLICING is that method of stoping in which the block of ore is mined from the top downward in successive slices, the timbered supports and overburden being blasted and caved as each slice is mined. Inasmuch as the overburden comes down as the result of forced caving, top slicing properly is classified as a "caving method." As practiced in the United States, the method appears to have been developed from old systems in use in some of the British iron mines.

Many similarities exist between top slicing and sublevel caving. In each operation, the ore is stoped out in short lifts, the essential difference being that in top slicing, all the ore is drilled, blasted, and timbered, and only the overburden, or capping, caved; whereas, in sublevel caving approximately one-half the lift of ore is drilled and blasted, the remaining 8 to 10 ft. being caved and the overburden subsequently brought down or caved, in a manner similar to that employed in top slicing. In regard to the amount of timber required, top slicing closely approximates square setting, but, as the stopes are caved, and do not require waste filling, it is a somewhat cheaper method.

As previously mentioned, top slicing is a timbered method, requiring no filling with waste, but the ground must be temporarily supported until the ore is extracted, when the supports are blasted and the back comes down. Either square sets, drift timbers, or posts with headboards may be used, depending on the character of the ground. The first slice is essentially a square set, with a timbered floor. When the supports are blasted, the mass of broken timber forms a mat over the head of the miners working the slice beneath, and prevents dilution of ore by waste from the overburden. The slices may be carried either horizontally or on an incline. In incline top slicing, all ore runs by gravity, whereas in horizontal top slicing, all ore must be shoveled up by hand or moved by scrapers.

Top slicing is now largely confined to northern Michigan and Minnesota. It is used in the soft hematite ores, where the capping is sandy and dilution is likely to take place. In the Southwest, it has almost entirely been replaced by the branch raise or combined shrinkage and caving methods. At one time considerable ore was mined by the incline top slice, but even though this method was very successful, it could not compete with the branch-raise caving systems, or with combined shrinkage and caving. Horizontal top slices are still found in a few camps, such as Globe, Bisbee, Cananea, and Jerome, but the tonnage produced is small compared with that mined by other methods. Approximately, 3,500,000 tons is produced each year by top slicing methods in Michigan, a smaller tonnage from Minnesota mines, and in Arizona, where a few years ago about 10,000 tons was produced daily, production from top slicing is now not more than 10 per cent of that figure.

This is the eleventh of the series by Mr. Mitke in which he outlines modern stoping practice.

Formerly, top slicing was considered particularly applicable to large orebodies having great lateral and vertical extent, containing medium hard, soft, or heavy ground and requiring clean mining. More recently it has been proved that in such deposits the branch raise or combined shrinkage and caving methods can be used to equal advantage, with very little or no increase in dilution, and an appreciably lower mining cost.

The real fields of top slicing at present are in flat orebodies where the vertical height is less than 60 ft. and the capping caves readily; in narrow veins with weak walls; in orebodies having great irregularity of outline; and in reclaiming portions of ore in the vicinity of old stoped areas. It can also be used to advantage in mining pillars between filled stopes and in recovering broken or caved ore.

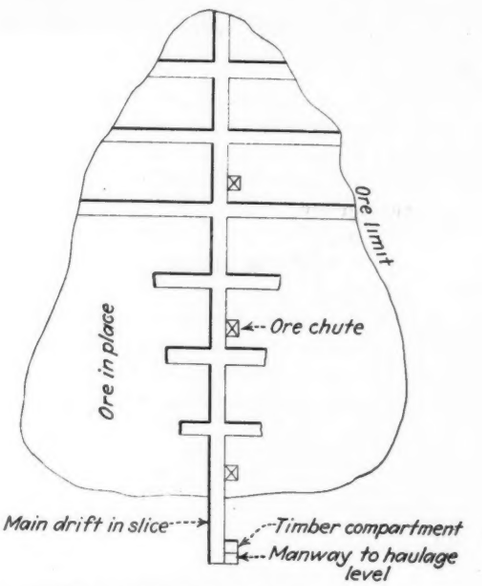


Fig. 1—Plan view of top-slice stope preparatory to stoping

Some selective mining can be practiced in top slicing, but the time involved in throwing out the waste into sections about to be caved adds considerably to the cost. If large horses of waste occur, they need not be mined, but should, at least, be broken up, and thrown into the caving section; otherwise they create undue weight and cause trouble in the floor, or slice, beneath and may break the timbers before mining is completed. It has even been found that cribbed bulkheads should not be left in top-slice stopes unless the timber is scattered or blasted before the floor is shot down.

In common with all other caving methods, top slicing should never be used where it is desired to avoid surface subsidence. Also, the method should not be used in highly pyritic orebodies, because of the danger of fire

breaking out in the timbered mat. It is almost impossible to prevent a certain amount of the fines containing pyrite from mixing with the timber. The constant friction and movement, caused by caving of the mat and overburden, soon results in the generation of considerable heat, with its accompanying fire hazards. As the mat is continuous over the top of the orebody, is always inaccessible from above, and is generally quite difficult of access from below, it is almost impossible to extinguish such a fire, once started. Top-slice stopes are also somewhat more difficult to ventilate than square-set stopes or other timbered workings.

Top slicing is not applicable in sections of an orebody where the area immediately above the proposed slice is considered good prospecting ground, as the result of extracting the ore by the method under discussion is to form a cone above the stope, the angle or break of which embraces quite a large area. These breaks usually go through to surface, and the further the top slice is carried down, the more broken becomes the formation within this area.

The capping over an area to be top sliced should be weak enough to follow downward with the slice. If it hangs up and forms an air space, it is only a matter of time before an air blast and cave will result. The actual time of the collapse depends on the area already opened up and the strength of the ground above. All ground has a breaking point. Some classes of ground will arch and hold up over larger areas than others, but when that breaking point is reached, they will give way and collapse, closing up the slice entirely.

Variations of Top Slicing

There are two general divisions of top slicing—horizontal top slicing and incline top slicing. A number of variations of horizontal top slicing are in use. These depend for distinction on the manner in which the top slices are timbered; the height and width of the slice taken; and whether hand shoveling or scraper work is employed to transport the ore. In some camps, these are variously known as "drift slicing," "square-set slicing," "top-set slicing," and "radial slicing"; in other camps they are given the name of the mine in which they are used, such as "Athens system of mining" and similar special designations.

With but few exceptions, stoping is started at the top of an orebody, and the ore is mined out in successive layers, or slices, across the top of the ore, mining progressing downward. At one particular property, the Athens mine, in Michigan, stoping is started at the lower extremities of the orebody, and progresses upward. However, this is possible only in comparatively flat deposits. In this instance, prohibitive top pressures are avoided, with a consequent saving in timber.

Several layers, or slices, may be mined at the same time, but the upper layers are always kept well in advance of the lower layers. Long raises connect the mining floor with the haulage level beneath, and also serve as storage pockets, the capacities of which diminish as mining progresses downward and the upper sections of the raises cave. Main levels are usually opened at 100-ft. intervals, and sublevels from 20 to 50 ft. These are caved in the regular manner as stoping operations progress downward. On each floor, or slice, drifts are driven out from the central raise, and timbered. Mining begins at the limit of the ore, at right angles to this central drift, and a panel, or section, approximately two to six sets wide, is mined out in a retreating fashion. The timbers are then shot down and the back caves, and a second panel, paralleling the first, is mined. In general, when a floor is shot down, it comes immediately, so that work in the adjacent panel may be started the next day. However, there are instances where it may take a week or two weeks for the blasted panel to settle. Stoping is continued in this manner until the entire floor, or slice, is mined out. The height of ore mined on each floor, or slice, varies from 9 to 13 ft. In a few operations higher lifts are mined, but when this is done, two

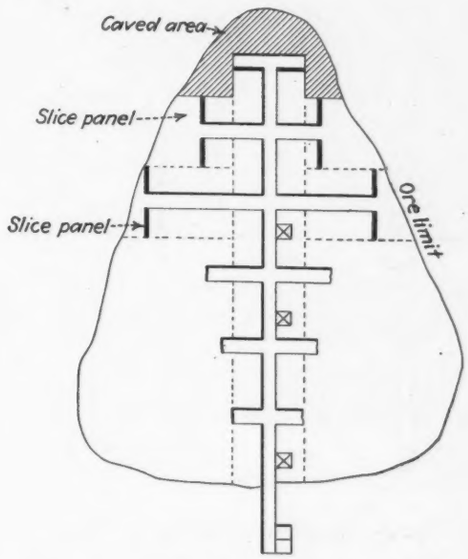


Fig. 2—Plan view of top-slice stope, after mining begins

or three sets of timbering are put up first, somewhat in the manner of tiers of square sets.

In top slicing, only the cheapest kind of timbering that will hold up for the short time that the slice is open is used. The time may only be from one to three weeks. Cheaper round timber has been found just as satisfactory as sawed square timber, and 2-in. flooring is customary, although 1-in. material is sometimes used. Frequently, holes are bored in the posts on surface, before they are taken underground, to avoid hand work in the slices. Small charges of dynamite (from one-half to one stick) are placed in these holes as soon as the panel is ready to be shot down.

Details of Horizontal Top Slicing

The development plan for horizontal top slicing is well known. A simple illustration of the development of a horizontal top-slice stope, with hand shoveling and hand tramming, is shown in Fig. 1; Fig. 2 is the same outline after stoping has begun.

In Fig. 1 (plan view), the main drift is first driven near the top of the orebody and parallel to the haulage drift beneath. Raises with ore chutes connect the two at 100-ft. intervals, and crosscuts are driven from the main drift every 50 ft., beginning at the extreme end of the orebody. After three of these crosscuts have been put in, stoping operations are started in the usual manner. Fig. 2, also a plan view, shows the various panels that are producing. In all, five panels are producing ore while the short crosscuts are being extended to the limits of the orebody, preparatory to stoping. The panels are taken back only to within 25 ft. of the drift, so as to protect this main entry. Stoping of this latter panel, or main drift, closely follows the completion of the side

panels. As soon as an area large enough to be blasted down is opened up the timbers are drilled and that part of the finished drift is closed.

Though this is the general plan, in many operations the crosscuts are driven at 40-ft. or even at 30-ft. intervals. Frequently, the ore chutes are located on 50-ft. centers, which requires additional development work. These drawings merely illustrate one slice, or floor.

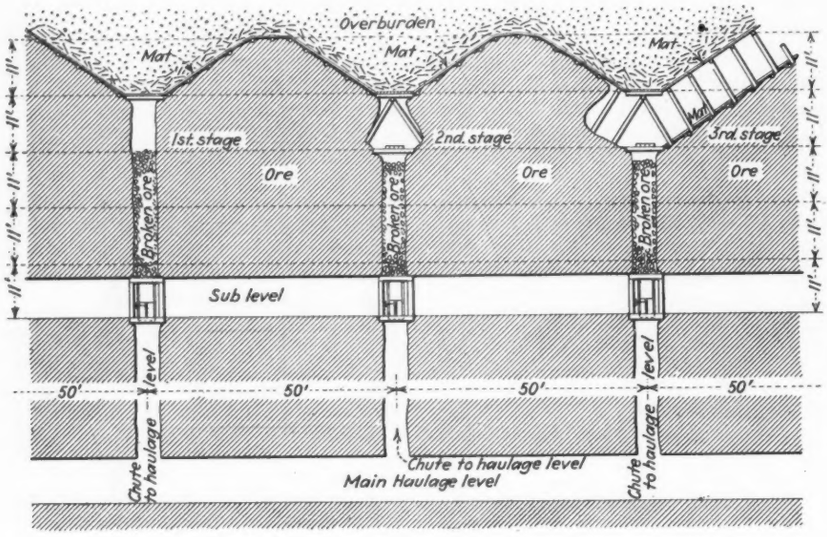


Fig. 3—Incline top slicing at Morenci, longitudinal view

After about 100 ft., horizontally, has been caved and closed, the work is started on the floor beneath, and the general scheme is repeated, both for development and for stoping.

Details of the Development Arrangement in Horizontal Top Slices for Scraper Loading

When scraper loading is applied to horizontal top-slice stopes, a somewhat different arrangement of the panels and chutes is necessary. A narrower panel is mined, and chutes must be spaced at more frequent intervals, and at convenient points, so that the scraper can operate efficiently. With the development for hand shoveling and tramming, the panels are generally laid out at right angles to the main drift containing the chutes. This presents no obstacles where all ore is shoveled by hand, but when scrapers are operated in the same layout, considerable difficulty is experienced in drawing the scraper around the 90-deg. turns, although this is being done in several instances. In other operations, this trouble is being avoided by laying out the panels in such a manner that they radiate from a central raise or chute, similar to the plan employed in certain sublevel caving stopes, and described in a previous paper.

Variations of Horizontal Top-Slice Stopes

On the Mesabi range a variation of horizontal top slicing is in use which consists in taking out two and occasionally three sets of ore, slices up to 26 ft. and over, in vertical height, being mined. The lower floors are mined out as usual, and timbering is carefully put in, so as to have good lagging overhead. Then rooms above are started and timbered, the ore being taken out in a retreating fashion. This, of course, is applicable only where the ground stands well. There are instances in the Pilares mine of Moctezuma Copper, at Nacozari, Mexico, where panels, two sets high, and sometimes even three sets high, were taken out where the ground stood well. Most of these panels were 15x30 ft. After all three floors had been mined out, the timbers were systematically blasted and the back was caved. When horizontal top slicing is applied to the mining of pillars between filled stopes, the method employed is very similar to that discussed under "details of horizontal top slicing." A typical example is the mining of pillars at the mines of the New Jersey Zinc Company.

In incline top slicing, the first slice, at the top of the orebody, is carried on the horizontal, and square-set timbering, with a good floor, is used to provide a substantial mat over subsequent slices. The next few slices are gradually inclined until the entire floor of the slice, from the central raise to the extremities of the ore, attains the desired angle, which is generally 33 to 35 deg. Ore usually runs well on this incline when a flooring is laid.

There is a choice between putting up the central raise, mentioned in the foregoing, or substituting for it a small shrinkage stope. When shrinkage is used, the ore slides into the stope (which is then a continuous chute) a little more readily than when raises, at intervals, are used. Not all ground will permit the use of these small shrinkage stopes, and where considerable timber is necessary, shrinkage is not practicable.

Fig. 3[1] illustrates the three stages of development, preparatory to forming a mat, and the general procedure in mining. In the third stage, the stope has already been finished on the right, and is now being carried up on the left; the second stage is being prepared to start just as soon as the third stage is finished. The timbers are all put up at an angle and blasted after the stope is completed. In Fig. 4[1] another view is presented, showing the various stages in perspective. The advantages that this method has over the horizontal are that all the ore runs directly into the chutes, and there is no hand work (in shoveling the ore) and no necessity to use scrapers. The posts hold up the mat just as well when set at an incline as they do when placed vertically. This has been proved by carrying horizontal and incline top slicing in the same mine and under the same conditions. As will be seen in Fig. 4, the overburden assumes a rill, or arch-shaped effect, which probably assists the timbers in holding up the back until such time as the supports are shot down. The peaks of ore existing between the chutes probably carry the larger weight of the overburden, as the weight at the chutes is seldom excessive.

So far, incline top slicing has not received the consideration which it deserves. Those who have had experience with both the horizontal and incline methods do not hesitate to use the latter wherever the height of ore, and other conditions, justify its introduction.

Comparison of Methods of Top Slicing

Though horizontal top slicing, with hand shoveling and hand tramming, has, until recently, been the more

[1] "The Coronado Top-Slice Method." P. B. Scotland, *E.&M.J.*, April 7, 1917.

general slicing method employed, it is by far the most expensive. Hand shoveling in top slicing is now being largely superseded by scrapers, thus effecting a saving of from 10 to 25c. per ton. Incline top slicing, where all ore is moved by gravity, is undoubtedly the cheapest of all top slicing, as even the scraper cannot compete with gravity. Though this method has been entirely replaced by the cheaper caving systems in large orebodies with great vertical extent, in the Southwest, nevertheless it would seem that it could be applied to advantage in many operations where horizontal top slicing is used at present and where the lift is 60 ft. or more.

The principal objections raised to incline top slicing are that no sorting can be practiced and that the men must work on an incline. Though it is not so convenient to sort in this type of stope, it has been done, and there are instances where waste chutes have been maintained in stopes for the running of waste only. In other operations several sets of timber have been lagged off and the waste has been picked from the ore on the floor and thrown into these sets. As regards working on an incline, the difficulty is no greater than in incline cut-and-fill or rill stopes. The angle of the floor of an incline top slice approximates the angle in these stopes, and is about 33 to 35 deg.

It has been proven beyond reasonable doubt that, where both will apply equally well, the incline cut-and-fill is a cheaper method than horizontal cut-and-fill, and the same reasoning applies in a comparison of horizontal and incline top slicing.

Timber consumption with the top-slice methods is high. In general, it ranges from 7 to 16 b.ft., depending upon the standing qualities of the ground. To give some idea of the quantity used, Miami Copper, in its old top slices, which covered an area of approximately 800 sq.ft., consumed about 60,000,000 b.ft. of timber.

Powder consumption is not excessive, because the ground is usually fairly soft. Powder and timber consumption is virtually the same in both the flat and incline methods.

Tons per man-shift range from three to fifteen, and even higher, depending on the type of labor employed; whether hand shoveling or scrapers are used to transport the ore; and the method of calculation that may be employed.

At the Coronado mine of Arizona Copper, where top slicing was used for several years, the horizontal method cost $1.14 to $1.31 per ton of ore delivered to haulage chutes, in 1916. After changing to the incline method in 1917, costs of 66c., 68c., and as low as 53c. per ton of ore delivered to haulage chutes were obtained, showing that wherever top slicing is to be used, the incline method deserves very careful consideration.[2] In this instance, the tons per man rose from 4.38 with flat slicing, to 11.20 with the incline method.

In another instance at the Humboldt mine, Morenci, where incline slicing and flat slicing were carried in the same orebody, the tonnage per man by the incline was greater than that with the horizontal, the first approximating 8.8 tons, and the latter 5.4 tons per stoping man. In the "tons per stoping man" figure is included timber men, and helpers, miners, muckers, and hand trammers. This was at a time when costs were highest (1918-1921), and labor and efficiency much lower than in 1916. The manager and superintendent stated that "The comparison of costs between the incline-slice method and the flat-slice system showed a reduction of 15 per cent in favor of the incline method for the four years under review, and proved that the application of the incline slice in these properties, to large ore areas, has been successful." [3]

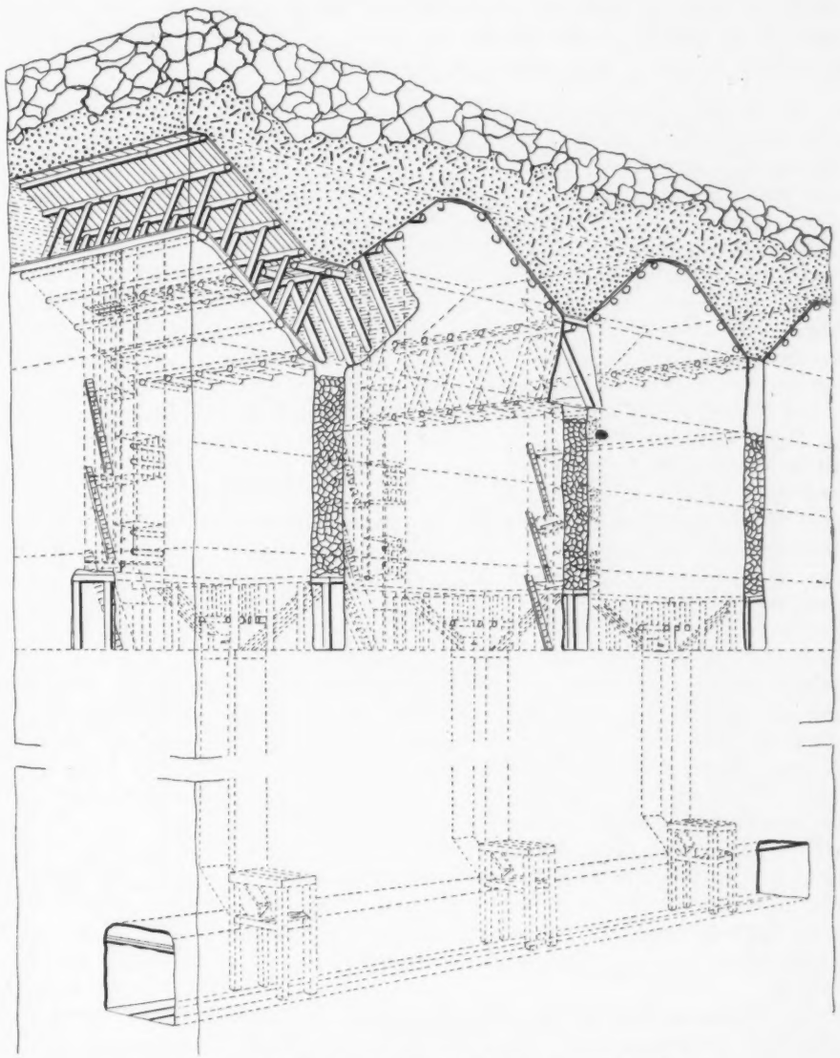


Fig. 4—Incline top slicing, Morenci, perspective

The so-called "block method" of flat slicing at Miami gave approximate total mining costs in 1916 of 88c. per ton, which covered delivery of ore to the mill bins.[4] At the El Bordo mine of the Cia. de Santa Gertrudis,

[2] "Incline Top Slicing." W. G. Scott, A.I.M.E. Vol. 59, 1918.

[3] "The Incline Slicing Method as Applied to Large Orebodies." J. P. Hodgson and John Kiddie. *E.&M.J.*, May 27, 1922.

[4] "Block Method of Top Slicing at Miami." E. G. Deane, *Mining & Scientific Press*, Oct. 21, 1916.

Pachuca, Mexico, the cost of flat slicing, with Mexican labor, was 74c. (labor, timber, and supplies).[5] In Bisbee, Cananea, and Jerome, where horizontal top slicing is used to mine out thin floor pillars or scattered remnants near old stopes, costs range from $1.50 to $2.15 per ton of ore mined.

It is difficult to obtain accurate costs on top slicing in the Michigan and Minnesota districts, but the average five-year cost for all underground mines in Michigan, from 1920 to 1924 inclusive, is given as $2.26;[6] and that for the single year, 1926, was $1.72.[7] Four underground methods were employed—sublevel stoping, shrinkage, sublevel caving, and top slicing. Of these, the last two are the most expensive, and account for approximately 25 and 50 per cent, respectively, of the total ore produced in 1926, which would seem to indicate average costs for these methods somewhat higher than the $2.26 and $1.72 figures given previously.

Evolution of Methods in the Southwest

Horizontal top slicing was used for many years in the Humboldt mine, in Morenci, until 1918, when a change was made to incline top slicing, with a consequent reduction in the mining cost of 15 per cent during the four years that this latter method was employed.[3] In 1923, a further change was made to the combined shrinkage and caving methods, with a still further reduction in the mining cost, indicating that though incline top slicing is considerably cheaper than the horizontal method, it cannot compete with either the branch-raise or the combined shrinkage and caving method.

At Miami, top slicing was used during most of 1916 to 1919, inclusive. The grade of the ore mined during those years ranged from 2.07 to 1.96 per cent copper, and the total operating costs from $1.119 to $1.54. The cost of labor and supplies naturally increased during the latter years, but was offset to a certain extent by the use of scrapers to handle the ore, especially in driving headings when opening up the various slices. As the grade of the ore decreased, and labor and supplies remained high, a change had to be made to a lower-cost mining method—undercut caving—and a reduction in mining costs of 24c. a ton was effected in 1920 over the 1919 operating costs. The cost of producing copper was reduced from 15.812c. to 11.898c. per pound. In the light of present-day caving methods, this undercut caving was really a high-cost method, as all ore had to be trammed by hand through heavily timbered drifts. This method has recently (1926) been entirely replaced by the branch-raise system, with its extremely low mining cost, approximately 37c. per ton, plus 0.148c. general overhead, and a cost per pound of copper produced of 10.62c.

In comparing top slicing with the branch-raise and combined shrinkage and caving methods, in orebodies where both are equally applicable, the general belief is that there is quite a high percentage of dilution with the latter methods, and practically no dilution, with complete recovery, by the top-slice system. Theoretically, this is correct; but, in practical operations, where large tonnages are mined by top slicing, and speed and efficiency must be practiced, because of the lean tenor of the ore, even in well-supervised top-slice stopes, accidental mishaps frequently occur—such as posts breaking when the slices become heavy, unexpected openings in the mat, allowing small runs of capping into the slice; and the impossibility of completely sorting out 100 per cent of the waste. Many of these occurrences may be unavoidable, but, nevertheless, they result in some dilution, and mining men have given it as their belief that the resulting dilution is approximately 4 per cent. In the branch-raise and combined shrinkage systems, the dilution, likewise, depends on the manner in which the work is carried out. However, it is not as great as is generally believed.

The "sand" in capping over the ore in the Michigan iron mines, where top slicing is practiced, corresponds closely to the "red dirt" in the capping over the low-grade copper orebodies in the Southwest, and presents practically the same difficulties. Under both conditions, the objectionable material is fine, is softer than the ore, and will readily run into crevices resulting from caving beneath. In Michigan, a timbered mat is used to prevent the sand from penetrating the top-slice stopes and mingling with the ore. In the porphyry coppers, the proper form of development work, including the close spacing of draw holes, and even drawing, prevents an excessive dilution from this source.

A factor which has largely contributed to the belief that there is considerable dilution with the branch-raise and combined shrinkage and caving methods is the fact that where these forms of caving are used, invariably there is a large over-draw; that is to say, the lower mining cost permits the mining of a much larger tonnage of ore, of a lower average grade, which gives the casual observer the impression that considerable dilution has taken place, whereas the additional ore, which has reduced the original average metal content of the whole, is material which, in the application of top-slice mining, would be considered non-commercial.

In mining by top slicing, the upper limits of the ore to be stoped are well defined, as mining is started only at a point where the grade is commercial for that method of mining, and any ore-bearing material of a lower grade which may exist above this point is caved and lost in the mat. Should the branch-raise or combined shrinkage and caving methods be applied to this same orebody, the stoping limits would be extended above this point, as the lower mining cost would make a large quantity of this material commercial. In other words, a large quantity of material that is considered as "waste" when practicing top slicing becomes "ore" when the branch-raise and combined shrinkage and caving methods are used. The addition of this lower-grade material to the original tonnage naturally reduces the average grade of the entire block to be mined.

As an illustration of this point: In 1918, Miami reported total reserves of high-grade ore, available for extraction, of 12,570,000 tons of an average grade of 2.38 per cent copper, which represented 55 per cent of the original estimate, or a life of about seven years, with an additional ore reserve of 36,000,000 tons of an average grade of 1.06 per cent copper (exclusive of mixed ores), which at that time was not commercial. In 1926, however, instead of, as might reasonably be expected, reporting a depletion of reserves, Miami reported a total reserve (exclusive of mixed ores) of 67,917,514 tons of sulphide ore, averaging 1.01 per cent copper. This figure included whatever might be left of the original high-grade reserves, together with the 36,000,000 tons previously reported, and a large quantity of adjacent

(*Continued on page* 95)

[5] "Top Slicing in Old Fills at El Bordo." R. J. Mechin, *Trans.*, A.I.M.E. Vol. 72, 1925.

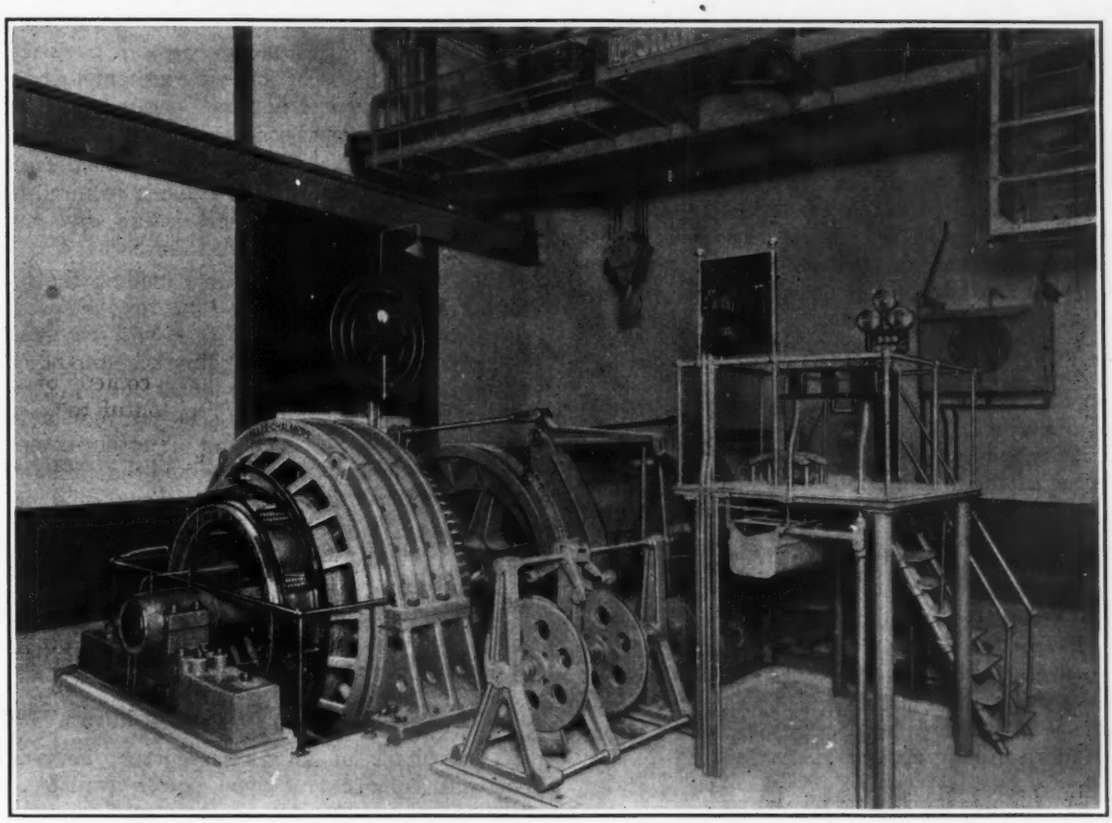
[6] "Michigan Iron Mining Industry." L. P. Barrett, Lake Superior Mining Institute. Vol. 74, 1925.

[7] Compiled by L. P. Barrett, State Appraiser of Mines.

Electric Operation of Hoists

By GORDON FOX
Frey Engineering Company, Chicago

AS MINES differ greatly in character, so mine hoists necessarily are of various sizes and types. Shafts may be either vertical or inclined. A single shaft or track and a single cable may operate unbalanced, or a double shaft and two cages or skips may operate in balance. Depths vary from a few hundred to 5,000 ft. or more. Metal mines are generally deeper than coal mines, averaging perhaps 2,000 ft. in depth, compared with an average depth of about 600 ft. for coal mines. The loads hoisted range up to five tons, and capacities up to 300 to 400 tons per hour are attained from deep mines. Hoisting speeds range as high as 4,000 ft. per minute. Motors range in size from 50 to 5,000 hp.



Mountain "Con" hoist of the Anaconda Copper Mining Company at Butte. Driven by a direct connected 1,000-hp. motor; rope pull 30,800 lb.; speed 1,500 ft. per minute.

In practically all mining underground, hoisting is done by winding a single cable from each cage or skip onto a drum or reel. Drum diameters are commonly 60 to 90 times the diameter of the rope, the larger drums being used for the deeper metal mines. A single drum may be used in connection with two ropes to the two cages or skips, one rope winding on while the other winds off. Two separate drums may be used for the two ropes. The choice depends on the type of drum and the location of the hoist with respect to the shaft, as indicated by Fig. 1. In Europe the Koepe pulley is sometimes used, which is somewhat similar to that used in the traction type elevator. Drums are cylindrical, conical, or may have both cylindrical and conical portions. The cylindrical drum is most used. It is simpler, cheaper, and lighter. It is adapted for deep mines in that two or more layers of rope may be wound on a drum of moderate diameter. It is suitable for operation from several levels. The purpose of the conical drum is to decrease the radius of rope pull when the full weight of cable is in the shaft and when accelerating the cage in hoisting. This type of drum reduces the peaks and smoothes out the load curve to a considerable extent, reduces the losses during starting, and requires a smaller motor. The conical drum is not suited for multiple level operation. Its chief application is for short lifts from a single level, such as often occurs in coal mining. Only a single layer of cable can be used.

The combination drum enjoys some of the advantages of both the cylindrical and conical types. In the operation of this type of apparatus, the cable may be wound in layers over the cylindrical portion. The advantage of

the conical shape is gained only if starting is from a single level. Conical and combination drums are of greater benefit to steam-driven hoists than to electrically driven hoists. Sometimes the drum is made in the form of a disk, and a flat cable is used, reeled on in a spiral. This has the objection that rope is costly and wear is excessive. Fig. 2 shows diagrammatically the general principle of the four most common types of mine-hoist drums.

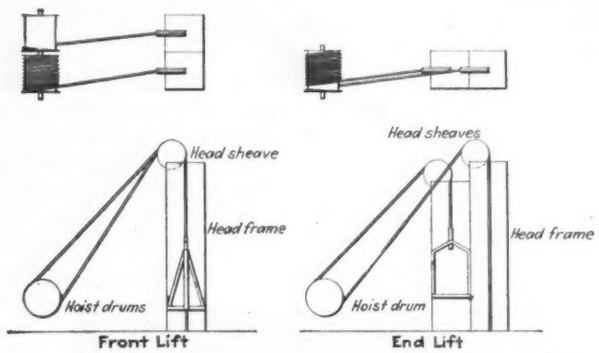


Fig. 1—Various typical arrangements of hoist drums and ropes.

Fixed drums usually are used for single-level mines or where frequent shifting between levels is unnecessary. Where hoisting is done from several levels, a usual practice in metal mines, a double drum is necessary and one or both drums must be provided with a clutch to permit adjustment of cables. All normally balanced hoists having one or more clutched drums must occasionally serve for out-of-balance hoisting, both for purposes of changing from one level to another and in the event of breakdown of one side.

With hoists using self-dumping cages or skips, about 30 per cent of the weight of the cage is borne by the "horns" when dumping. This results in an increase in initial torque requirement.

Most main hoists operate in balance, as the tonnage which can be obtained for a given load and rope speed is approximately double that for an unbalanced hoist. Power consumption is lower, and less capacity is generally required in drive equipment. Slope hoists are more commonly single track and operate unbalanced. For slopes up to about 3 per cent grade, electric locomotives are more usually applicable.

Electric Drive System

Electric drive is well suited to many mine hoists. The service is more or less intermittent, and the power varies over wide demand. Moreover, fuel and water conditions are frequently unfavorable for the generation of steam power, whereas electric power may be purchased or generated at more favorable locations and transmitted. There are four general systems of electric drive for mine hoists, namely:

1. Direct-current motor with resistance control.
2. Alternating-current induction motor with secondary resistance control.
3. Direct-current motor with Ward-Leonard variable voltage control.
4. Direct-current motor, variable voltage control with Ilgner set.

The direct-current motor, with resistance control is used for only a few of the smaller hoists—say below 300 hp. The drive is then similar to the general-service unbalanced hoist or the balanced skip-hoist, as circumstances may determine.

Induction Motor Hoists

Wound-rotor induction motors with secondary-resistance control are widely used, and range in size from 50 to 1,800 hp. They have the advantage of relatively low first cost and no idling losses. They also have the disadvantages that they give less accurate and complete control, have high starting peaks, and are not inherently well adapted for lowering.

Induction motors have been direct-connected to the drum shaft, but almost universally they are geared, a single reduction through herringbone gears being popular. This type of gearing permits a high ratio of reduction, up to 15 to 1, giving a fairly high-speed motor, which has good efficiency and adequate power factor. A two-bearing motor usually is provided, connecting to the pinion shaft through a flexible coupling. The brakes act directly upon the drums. They are actuated by hand or by weights in conjunction with air or oil cylinders.

Several methods of lowering are employed in connection with induction motors operated with unbalanced loads. They comprise:

1. *By mechanical brakes with variable tension*—This method is wasteful, a large brake is required to dissipate the heat, wear of brake shoes is excessive, and there is danger in the event of brake failure.

2. *By regeneration*—In this method the motor is in circuit and is driven above synchronous speed as an induction generator. It is stopped with the brakes, aided, in some instances, by "plugging" the motor on the first point. This method is practical for long hoists only, where high speed lowering is permissible and where sufficient time is afforded for the rather complex operation of the electrical controller and the mechanical brakes in conjunction. It is particularly applicable on slopes.

3. *By retardation with "plugged" motor and high secondary resistance*—This method tends to better control and is adapted to short shafts. It is, however, very wasteful. The secondary resistors must dissipate the entire input from the line, and, in addition, the braking energy developed by the motor.

Controllers for Induction Motor Hoists

The voltage of alternating-current hoist-motors depends to some extent upon power available. For the smaller equipments 440 volts is well suited. For the larger equipments 2,300 volts is to be recommended. The smaller motors, up to about 100-hp., are frequently provided with drum controllers handling both primary and secondary circuits. This arrangement does not offer much opportunity for protective features. A good combination is that which utilizes magnetic primary contactors together with a drum which combines the functions of master switch and secondary controller.

Induction motors ranging in size from 100 to 1,000 hp. are usually equipped with full magnetic control. A number of secondary-resistance steps are provided to afford smooth acceleration with the development of necessary torque and to provide slow-speed regulating points. Magnetically controlled equipment is easier to operate. Rapid acceleration may be safely secured by current-limit or time-element control. Magnetic control is particularly adapted to fast cycles. Protective features may be applied; and operation can be made largely automatic.

The larger hoists, having motors in excess of 800 hp., usually are equipped with magnetic primary control in conjunction with a liquid rheostat for secondary resistance. If the primary voltage be 2,300 or 6,600 volts, a special type of high-voltage air-break contactor is required. Oil-immersed contactors are not satisfactory for this service, as the frequent duty causes the oil to carbonize rapidly. Liquid-rheostat secondary control offers a number of advantages. For the larger motors the quantity of grid resistance required would be great and the secondary current large to be handled by contactors. In the liquid rheostat, automatic time-element acceleration is obtained because of the limited rate of flow of the electrolyte. Acceleration is uniform as a consequence of the gradual change in resistance corresponding to a multiplicity of steps. Accurate speed control is possible, for the same reason. A predominating advantage is the ready means of heat disposal through use of circulating water. The liquid rheostat is especially adapted to service involving considerable periods of operation at less than maximum speed. This type of rheostat has a number of disadvantages or shortcomings, however, namely:

1. Continuous losses caused by the inherent resistance of electrolyte.
2. Necessity of cleaning cooling coils, plates, and electrodes at intervals.
3. Difficulty of repair if a breakdown occurs.
4. Repairs may require some time.
5. Water cooling of electrolyte may be a disadvantage where water is scarce.

Skill and attention are required to maintain the electrolyte at proper density. The choice between magnetic control and liquid rheostat must be a compromise, based on the individual operation.

Ward-Leonard Direct-Current Drive

The alternating-current motor is not inherently well adapted to hoisting service. Alternating-current hoists are widely used, largely because electric power is most readily available in that form and the induction motor affords the simplest and least expensive installation. From an engineering point of view the variable-voltage, direct-current system, commonly termed the Ward-Leonard system, is nearly ideal. The hoist motor is a d.c. shunt-wound low-speed machine, direct-connected to the drum shaft. Power for driving this motor is taken from a d.c. generator which is part of a motor-generator set. The voltage of this generator is reversed, increased and decreased by manipulation of its field excitation. The resulting reversing and varying voltage impressed upon the hoist motor causes it to reverse and vary its speed to conform. At any given generator voltage the hoist motor maintains a closely fixed speed regardless of load. If the load is overhauling the hoist motor becomes a generator and pumps into the motor-generator set. This action takes place automatically and with little change in speed of the hoist motor. The motor-generator set used with the Ward-Leonard system consists of the d.c. variable-voltage generator, an a.c. driving motor, and a small exciter, the latter to supply the fields of the d.c. generator and hoist-motor and the hoist-brake magnets. In this unit, the a.c. motor may be of the induction or synchronous type. The synchronous motor is of advantage in the matter of power factor. The induction motor is likely to be lower in first cost and may have a higher "pull-out" torque that may be advantageous in connection with wide load fluctuations. Synchronous motors may be supplied having a pull-out torque entirely commensurate with the requirements, a larger frame being generally applied. Induction motors are more commonly used. If a synchronous motor is used, its fields are supplied from the common exciter unit.

Control for System

As previously stated, control of the hoist motor is obtained by governing the fields of the generator unit. In most installations the generator field-current is handled and adjusted directly in a drum or face-plate controller, manipulated by the operator. For very large installations, as well as some of the smaller ones, magnetic contactor panels have been provided to handle the generator-field circuits, the magnetic control, in turn, responding to the operator's master. Manually operated controls are often mechanically interlocked with the hoist drum to restrict the rate of manipulation and to provide automatic shut-off on approaching the limits of travel. Magnetic control is more readily arranged for automatic acceleration and retardation and the provision of protective devices.

Advantages

The Ward-Leonard system offers many advantages. Owing to the absence of starting resistance, practically all resistance losses are avoided. Steady operation without heavy losses may be secured at any desired speed under the maximum. The system is particularly good for handling men at reduced speed. As the field circuits only are controlled, it is easily possible to provide a large number of speed points. Retardation is obtained by regeneration, and the hoist may be brought to an accurate stop before the brakes are applied, relieving them of wear. As previously stated, the alternating-current motor is not well adapted for retarding unbalanced loads. With Ward-Leonard controls the hoisting motor drives or retards with equal facility. Moreover, in retarding, power is returned to the system.

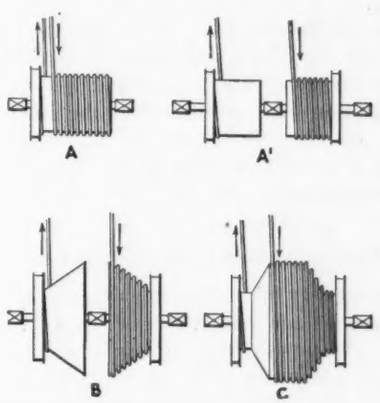


Fig. 2—Diagrammatic sketches showing principal types of mine hoist drums

In a deep mine provided with balanced hoist, the cable weight of the down-going skip may gradually overbalance the load being hoisted. It is difficult to retard such a load with an induction motor. Introduction of secondary resistance merely increases the speed unless the motor is plugged. With rheostatic control it is difficult to maintain constant reduced speed and the brakes must be depended upon largely for slow-down and stop. The Ward-Leonard system is excellently adapted to automatic acceleration and slow-down, and permits protective

features which cannot be applied so effectively to alternating-current hoists. Sometimes the field of the hoist motor is weakened to afford emergency high-speed operation. In brief, the Ward-Leonard system is ideally adapted to positive, efficient, accurate, and flexible control. This is accomplished at the expense of additional equipment. Moreover, the losses in the motor-generator set, which runs idle perhaps 50 per cent of the time, largely offset the gain in efficiency made possible by elimination of resistance losses. The variable-voltage system is at its best, so far as efficiency is concerned, for short hoist trips where acceleration and retardation are a large part of the cycle, and for busy hoists. The Ward-Leonard system of variable-voltage control is used for hoists the control of which requires a high degree of accuracy and the importance of which justifies the greater investment. Induction-motor drive is employed for small and medium-capacity hoists, and where first cost is of prime importance and exact control not imperative.

Ilgner System

Hoist duty involves heavy accelerating current-peaks and sometimes retarding current-peaks in the opposite direction. Fluctuations in load are thus very pronounced. Hoist motors are usually large machines, and their peaks may be large in relation to the power system. It is therefore imperative under some conditions and advantageous in many, that the load demand be equalized and that excessive peaks be eliminated. As these peaks are normally of short duration, the flywheel represents the best means of energy storage and equalization. The most frequently used method of application of this device is the Ilgner system. This comprises essentially a Ward-Leonard equipment with a large flywheel connected to, or made a part of, the motor-generator set.

The a.c. motor driving the set is a wound-rotor induction motor. A liquid slip-regulator is provided, which automatically increases the secondary resistance in the circuit of the induction motor when the load exceeds a stated value, causing the motor to slow down so that the flywheel may absorb the peak demand. During periods of regeneration or idling, the flywheel is again accelerated.

Advantages of Ilgner System

The Ilgner system offers the advantages of the simple Ward-Leonard system with the added advantage of load equalization. As power charges are usually based upon demand as well as consumption, this may be an important consideration. The Ilgner system used on a short cycle enables the use of a smaller a.c. motor driving the set, as the load on this motor is limited, whereas with the simple Ward-Leonard system the a.c. motor handles all of the load peaks and must therefore have a high pull-out torque. A deterrent to the use of the Ilgner system is its high cost. Moreover, the idling losses of the motor-generator set are higher than those of a simple Ward-Leonard system, owing to the flywheel windage and bearing friction.

Ilgner sets ranging in size from about 300 to 1,500 hp. hoist-motor rating are used in coal-mine service. Larger equipments from 500 hp. to 4,000 hp. capacity are used for metal mines, which are usually deeper. Because of the greater depths and longer cycles, the flywheels for metal-mine hoists are usually larger.

The matter of first cost is an important factor in determining the type of drive to be employed. Where the more costly drives are utilized, the additional cost must be justified by the advantages gained. As a guide to relative costs of the different types of drive, the following typical figures are included, showing relative present-day costs.

Wound-Rotor Induction Motors for Geared Drive

200-hp. 600-r.p.m. 2,200-volt 3-phase 60-cycle induction motor with magnetic control and switchboard, $22.50 per horsepower.

Same with liquid rheostat secondary controls, $31.50 per horsepower.

600-hp. 450-r.p.m. 2,200-volt 3-phase 60-cycle induction motor, with magnetic control, $15 per horsepower; with liquid rheostat, $17.50 per horsepower.

1,300-hp. 360-r.p.m. 2,200-volt 3-phase 60-cycle induction motor, with magnetic control or liquid rheostat, $14.50 per horsepower.

Direct-Current Motor Geared to Hoist Drum, With Motor-Generator Set and Ward-Leonard Control

800-hp. 350-r.p.m. 550-volt d.c. motor, 700-kw. motor-generator with 500-kva. synchronous motor, $36 per horsepower.

800-hp. 350-r.p.m. 550-volt d.c. motor, 700-kw. motor-generator, with 600-hp. induction motor and 18,000-lb. flywheel. Ilgner control, $48 per horsepower.

Direct-Current Motor, Direct-Connected to Hoist Drum, with Motor-Generator Set and Ward-Leonard Control

950-hp. 93-r.p.m. 550-volt d.c. motor, 700-kw. motor-generator, with 500-kva. synchronous motor, $43.50 per horsepower.

950-hp. 93-r.p.m. 550-volt d.c. motor, 700-kw. motor-generator, with 600 hp. induction motor and 18,000-lb. flywheel, $53.50 per horsepower.

Limiting and Protective Devices

Mine hoists are nearly always operated by a man. Control is more or less manual. The operator always starts hoisting and usually stops. Acceleration usually is limited automatically to a safe rate. All mine hoists are equipped either with hand-operated brakes or with power-operated, hand-controlled brakes. Where clutched drums are involved, there is a brake for each drum. Power-operated brakes are set by gravity and released by thrust cylinders employing either air or oil under pressure. By means of a "floating-lever" system the operator has close control of the braking. Limit switches are provided to supplement the operator and to slow down and stop the hoist if the operator fails to do so. With variable-voltage control, the limit switches are arranged for automatic slow-down and stop. Induction-motor drive is not so nicely adaptable. A limit switch is generally provided to function in connection with a centrifugal switch, so that, if the hoist is not slowed down by the operator before the limit switch is reached, the motor will be disconnected from the line and the brakes will be set. Protective devices are desirable against (*a*) failure of power; (*b*) failure to slow down and brake; (*c*) starting too fast; (*d*) overspeed; (*e*) overwind; (*f*) overload; (*g*) accidents, such as a sticking cage.

The efficiency with which hoisting is accomplished varies widely, being influenced primarily by the depth of shaft, frequency and speed of the cycle, and type of hoisting equipment. The efficiency with which a given tonnage may be hoisted is greater as fewer heavier loads are handled. This is particularly true as applied to short lifts.

Induction-motor drive involves rheostatic losses of considerable magnitude during the starting interval. With shallow mines and frequent cycles this item is of greater relative importance than in operations in deep mines which involve less frequent starting. The use of Ward-Leonard control eliminates largely the rheostatic losses, but introduces idling losses in the motor-generator set, these being of considerable magnitude when large flywheels are involved. The efficiency of this type of drive varies therefore with the continuity of the service. In general, hoisting efficiency is higher when capacity loads are handled each trip as contrasted with a greater number of trips with light loads. This is particularly true of induction-motor drives. Usually, the over-all efficiency of mine hoists may be given as from 40 to 60 per cent.

Principles and characteristics of the various types of mine-hoist drive have been considered. It is now in order to investigate a little more precisely the load cycle of a mine hoist, and to outline the principles governing selection of size of motors and auxiliary equipment.

Load Characteristics

The elements which make the load on a mine-hoist motor are: hoisting dead load against the force of gravity; acceleration and deceleration against inertia of moving members; and friction. The first element is proportional to the net weight hoisted and the velocity of travel. In any hoist of appreciable depth the weight of the cable is an important factor. As this weight continually changes, the net weight being hoisted continually varies. In the operation of the usual balanced hoist, one rope shortens while the other lengthens, increasing this effect.

If the rope speed is comparatively high, 1,000 f.p.m. or greater, and if the time for the trip is rather short, the power required for acceleration and retardation will be factors of primary importance in determining the motor size. The torque required to accelerate or retard the load, cages, cable, hoisting engine, and motor armature depends upon the inertia of these parts and the rate of acceleration and retardation. The inertia of all parts may well be translated into inertia at any selected radius at the drum shaft. On cylindrical drums, the inertia of the load, cages, and ropes may be taken as having a radius of gyration equal to the drum radius. The inertia of the drums may be obtained from manufacturer's data or may be approximated from the general dimensions of the equipment. Wherever it is possible the manufacturer's data should be used, as approximate figures may be decidedly in error. This is particularly essential when drum inertia has a prominent influence on load and performance. The inertia of the gearing may be, in general, put at about 10 per cent of the drum inertia. Power requirement during retardation may be either positive or negative, depending upon the relative values of ascending and descending loads, the inertia of moving parts, and the rate of retardation. In deep mines the rope weight may be such that the descending empty cage overcomes the pull of the ascending loaded cage as the latter approaches the surface.

Domestic Cadmium Production Increases One-Third

PRODUCTION of metallic cadmium in the United States in 1927 amounted to 1,074,654 lb., an increase of 33 per cent over production in 1926, as reported by producers to the U. S. Bureau of Mines. The market quotation on American metal, New York, remained at 60c. a pound throughout 1926 and 1927. There were 22,400 lb. of cadmium, valued at $13,172, imported into the United States during the last quarter of 1927. No imports of this metal were recorded for 1926 or the first three quarters of 1927. In addition to metallic cadmium, domestic manufacturers reported some production of the following cadmium compounds, all in larger quantity than in 1926: Cadmium sulphide, cadmium hydrate, cadmium oxide, and cadmium lithopone, but figures are not available for publication.

Demand for cadmium for plating has recently showed a marked increase, and the price has risen to 65c. a pound.

The Electrolytic Zinc Company, at Risdon, Tasmania, is an important producer, and recent imports, on which a duty of 15c. per pound is levied, may have been of Australian origin.

Mining Ore by Top Slicing

Continued from page 90

low-grade ore not included in former estimates, and which, in 1918, was not considered commercial, as the mining methods employed at that time (top slicing and undercut caving) did not permit the mining at a profit of such low-grade material.

A glance at the latest company report (1927) will indicate that these figures have now been expanded to a total ore reserve of 84,586,743 tons of still lower grade —namely, 0.93 per cent copper—which, with present low mining costs, has now become "ore." This does not imply dilution, as the ore was and still is in place, but represents the average metal content of a very large body, which not only includes the original estimates but considerable adjacent ore, which in former years was considered waste. The cost of producing copper has been reduced from 14.83c. per pound in 1918 to 10.62c. per pound in 1926.

To a large extent the same situation exists in Morenci, where a large tonnage of low-grade ore exists, which, during the period when top slicing was employed, was considered non-commercial. Since low-cost caving methods have been developed, this has now become "ore."

An expansion of ore reserves has also taken place at both Ray and Inspiration, but this is not the result of a radical change in the mining methods, as no top slicing was ever employed in these camps, but rather to improvements and reductions in the cost of the original caving and shrinkage methods.

THE twelfth and last of this outstanding series of articles by Mr. Mitke on modern stoping methods will be published in about a month. It will cover stope control, and dilution and recovery, with caving methods. So great has been the demand from college professors and others for reprints of this material that it has been decided to collect and publish the articles in book form. Subscribers to E.&M.J. in the year since this series began, on Sept. 10, 1927, thus have received the contents of a book on mining practice for their price of subscription; the rest was "velvet."

The International Smelter

and the

Miami Copper Concentrator

Part XI: Revisiting Arizona Mining Camps

By E. H. ROBIE
Associate Editor

THE International smelter is a subsidiary of the Anaconda Copper Mining Company. It is near the Inspiration and Miami concentrators, and treats all the concentrates produced by those two plants, together with those from the Old Dominion, at Globe, a few miles away. L. O. Howard has been the superintendent of the International smelter for many years.

Of chief interest to me was the feeding of raw concentrates to the reverberatory furnace. A. D. Wilkinson, who developed the practice of feeding damp concentrates direct, without roasting, at Cananea, instituted a similar system here last year, while temporarily in charge of the plant. The practice is not yet standardized, especially as regards the method of feeding such troublesome stuff, nor is it yet possible to determine exactly how much money, if any, is saved by the new procedure. The cost of putting the ore through the Wedge furnaces, which were formerly used here largely as driers, is, of course, entirely eliminated. Damp material, however, proved difficult to distribute to the reverberatory charge hoppers by the drag conveyor formerly used for the calcine, the labor bill being excessive.

At the time of my visit, one reverberatory was equipped with a belt feeder and tripper, discharging into special hoppers along the side of the furnace. This was an improvement, though even larger drop-holes appeared to be necessary to secure a free fall into the furnace. With the difficulty in feeding, an unusual amount of cold air was introduced through the charge holes into the furnace, which, of course, was not conducive to a low fuel ratio. The fact that the material was wet and cold instead of dry and hot also made more heat necessary for smelting it. Comparative gross fuel ratios with dry and damp feed are about 0.57 bbl. of oil per ton, and 0.98. The tonnage smelted is about the same—about 500 tons of solid charge a day with the amount of fuel given above, in a 21x120-ft. furnace. One furnace—No. 4—is larger, 25x120 ft. The slag loss is less with wet feeding, being apparently about 0.1 per cent copper lower with the same grade of matte. This is attributable chiefly to the fact that there is no dusting in the furnace; no settling of dust on top of the slag layer, which is skimmed off and poured on the dump. Absence of magnetite, which is normally produced in a roasting furnace, is generally considered to be another advantage of wet charging.

Under the former International practice, the sulphur in the bedded ore and concentrates charged to the roasters was reduced about 6 or 8 units, sufficient to produce a 40 per cent matte. Molten converter slag was also poured into the reverberatories, the combined slag sent

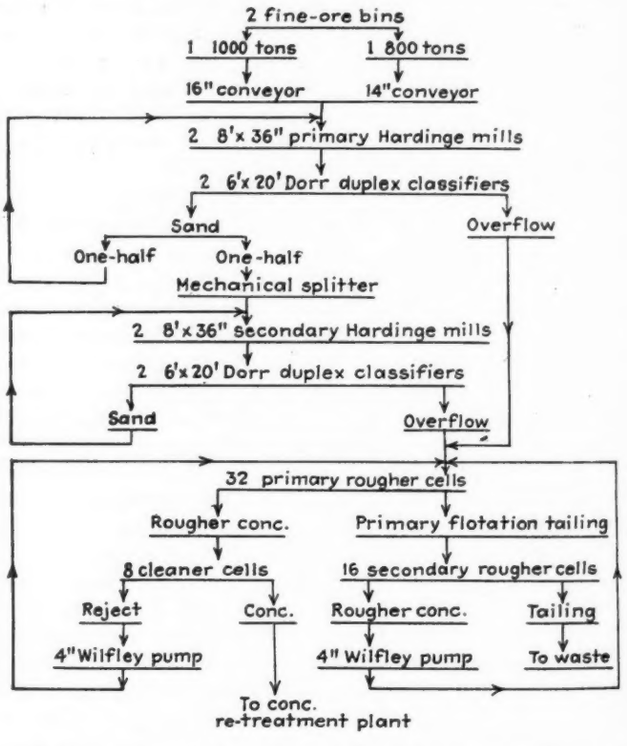


Fig. 1—A typical section of the Miami concentrator

to the dump having about the following compositions: Cu, 0.6 per cent; SiO_2, 33; Al_2O_3, 8; Fe, 41; and CaO, 1 per cent. Basic fluxing material is at a premium, and the silica plus alumina in the reverberatory slag would often run as high as 65 to 75 per cent were it not for the addition of the converter slag. With the wet-charging of somewhat higher-grade concentrates, the matte

at the time I was there was about 45 per cent, and a representative sample of the slag assayed as follows: Cu, 0.56 per cent; SiO_2, 33.1; Al_2O_3, 9.6; FeO, 50; and CaO, 1.4 per cent.

Other features of the International smelter follow standard practice pretty much, with no recent changes. Upright 12-ft. Great Falls type converters are used, and straight-line casting machines.

The Miami Concentrator

I regret that time did not permit my going underground at the Miami Copper Company's mine, nor of talking over recent progress with F. W. Maclennan, the general manager, to whom much credit is due for the rejuvenation of this property. The low cost—around 40c. per ton—secured by the caving method of mining adopted in 1925 has already been mentioned. It is of interest that the mining cost, which was 41.6c. per ton last year, was almost exactly the same as the milling cost, which was 41.3c. This last was made up as follows:

Cost of Concentrating Miami Ore

	Cents per Ton
Coarse crushing and conveying	9.4
Fine grinding	13.3
Flotation	8.5
Concentrate re-treatment	1.7
Concentrate disposal	0.8
Tailing disposal	1.4
Water	2.4
General mill	3.8
Total	41.3

Based on copper produced, Miami's mining cost is 3.2c. per pound, and its milling cost the same, to which must be added general expenses of 1.3c. per pound, making total cost of production of copper in the form of concentrate, 7.7c. per pound. Smelting, refining, and marketing added 3½c. to this total, making the total cost of refined copper 11.2c. per pound. When it is considered that the ore mined contained only 0.85 per cent copper, of which 0.14 per cent was in the form of oxide, the low costs are indeed remarkable and reflect the greatest credit on the management and technical staff.

I shall not here take up the mining methods, but I do want to mention briefly the company's timber-treatment plant. Mine timbers are treated with zinc chloride to secure their preservation, a procedure that is considered well worth while. An average of 0.64 lb. of this preservative is absorbed by a cubic foot of wood.

Development of the large low-grade orebody at Miami brought a very real problem to the metallurgical staff. Formerly, practically all of the sulphide mineral was chalcocite, and there was no particular difficulty in securing a 40 per cent concentrate without devoting special attention to dropping the iron. With the lower-grade ore now being mined, however, most of the chalcocite occurs as a deposit on particles of pyrite, so that, on the pulp as it had been ground—to 48 mesh—using the former methods, a concentrate containing only about 20 per cent copper was the best that could be obtained, even by attempting selective flotation methods. There was no particular trouble with the tailing—this could be kept around 0.2 per cent copper, of which half was oxide—but the concentrate was too low-grade for profitable smelting. Very fine grinding was necessary to part the pyrite and chalcocite; this was unusually expensive on account of the hard, siliceous composition of the gangue, and was not feasible with the grinding equipment at hand. It was therefore decided to make a bulk float of all sulphide at 48 mesh, and subsequently to make a selective separation of the iron and copper sulphides after grinding to 200 mesh. Working out this problem has occupied most of the time of Harry D. Hunt and his assistants, Messrs. Mountjoy and Smith, for the last year or two. Results have already been excellent, but a further marked improvement in the current year is expected, with finer grinding.

The ore, after being crushed to about ¼ in. in gyratories and rolls, instead of ⅜ as formerly, is ground in two

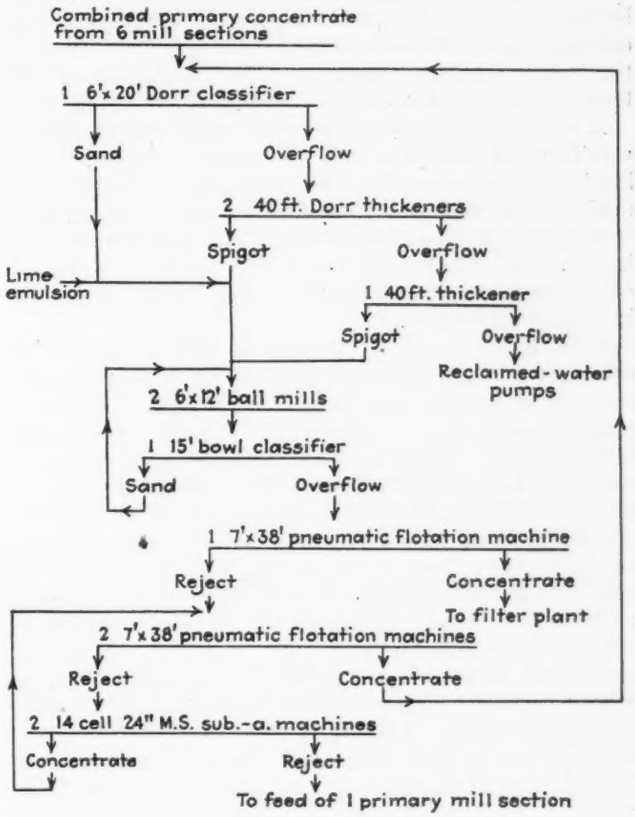


Fig. 2—Flow sheet of the re-treatment section, Miami concentrator

closed-circuit Hardinge mills per section, there being six sections in the plant. The sand product, after classification, is separated into two parts, each of which goes to another Hardinge mill in closed circuit with a drag classifier. Classifier overflow, 10 per cent of which is coarser than 48 mesh, then follows the flow sheet shown in Fig. 1. This makes a final tailing and an 18 per cent concentrate, which is combined with that from the other five sections of the concentrator, the whole going to the re-treatment plant, the flow sheet of which is shown in Fig. 2. There seems no good reason to go into detail here regarding these flow sheets; current practice can be understood by studying them (they are corrected to July 1), but before long, changes will no doubt have been made which will void certain sections. It may be of interest, however, to discuss certain features of the crushing, grinding, and flotation practice.

Of chief interest in the crushing department, I found one of the Newhouse gyratory crushers which Allis-Chalmers have recently been developing. These have not yet been put on the market. The machine, which has a 14-in. opening, has several unusual features, as, for instance, the method of support. Instead of standing on a foundation, it is suspended by cables from corner pillars. It is driven by an overhead motor operating at 480 r.p.m.;

when running light the cone makes 10 or 12 r.p.m. in the same direction as the motor, as it gyrates, but when under load the cone goes in the opposite direction. Without being familiar with the construction of the machine I will not undertake to say why this is so. A rather elaborate lubrication system is provided. The crusher appears to consume less power and to require considerably less expense for upkeep than the type of gyratory formerly installed here, and it is looked on very favorably by the operators. It also has a greater capacity than the ordinary gyratory of its size, and a larger ratio between the size of feed and product. It is crushing about 200 tons per hour to 1¼ in. and consumes 0.32 kw.-hr. per ton.

A dust-collecting system for the rolls and gyratories was installed last year and has solved a problem that has been troublesome for some time. Some attempt was made to use cyclone collectors, but they were unsatisfactory, so that practically all of the dust is now recovered in the form of wet pulp in settling chambers equipped with sprays, the dust particles largely being caught by impinging on a wet surface.

Grinding in the Hardinge mills is now planned to be carried finer than in former practice when about 10 per cent of the flotation feed was plus 48 mesh. The percentage is now about 2½ per cent on one mill section, and this practice is likely to be extended. This means a capacity of about 30 tons less per mill per day, but a saving of about half a pound of copper per ton of ore is thereby secured. Last year, for example, the average sulphide copper loss in the tailing was 0.095 per cent copper; it has now been brought down to 0.050 in the one mill section, largely through finer grinding and more efficient flotation. The regrinding of the concentrate is carried out in 6x12-ft. tube mills, using 1-in. balls as the grinding medium. Only about 4 per cent of the product is plus 200 mesh. Though it is necessary to grind so fine to free the chalcocite from the pyrite, a very real loss of fine slimed chalcocite in the tailing results, for it must be remembered that the re-treatment tailing goes back to the primary grinding mills.

Unusually careful control of the addition of reagents, as to quantity and place, is necessary. Conditions must be such in the re-treatment department, as to float chalcocite and depress pyrite. The tailing from this department going back to the primary mills contains 7 or 8 per cent of copper. In the primary circuit that handles both original ore and the re-treatment tailing, therefore, it is necessary to float the pyrite and attached chalcocite in the original ore, the chalcocite in the re-treatment tailing, and to drop the pyrite in the re-treatment tailing which has no other way of getting out of the plant. This may seem a little complicated; but it is no more complicated than is the problem. The amount and time of addition of lime is the most important factor in maintaining this control; it is a marked depressant of pyrite, and the grade of concentrate can be increased greatly by carrying a high alkalinity. On the other hand, a high lime circuit also depresses the finely ground chalcocite in the re-treatment tailing.

The following reagents are used per ton of ore: Lime, 2.1 lb.; xanthate (crystals), 0.07 lb.; and pine oil, 0.15 lb. Lime is added to the primary ball mills; to the fresh and reclaimed water in the tailing ponds which supply all of the mill requirements; and to the classifiers in the re-treatment plant. Almost anything can be done with lime, so far as control is concerned, that can be done with oils or other more specific flotation reagents. The time factor is also important. Phospho-cresylic acid has been experimented with, but on the Miami ore treated no advantage is gained by its use; the concentrate is no higher grade and the tailing is not as clean.

Until recently the conventional type of porous mat pneumatic flotation machines and the Minerals Separation machines have been used at Miami. In the last year or so, however, machines of the free air type have been installed in which the air is admitted to the bottom of an elongated launder through a multiplicity of small pipes led down into the pulp from an air main that extends along the top of the cell. The particular variation of this idea which has been developed by Harry Hunt has been described briefly in my notes on the United Verde mill, in the May 5 issue. Continued development work is being done on machines of this type by Mr. Hunt, but the results already secured are said to be much superior to those obtained with the equipment formerly installed.

Metallurgical Data of the Miami Copper Company for 1927

	Per Cent
Total ore milled, total copper	0.855
Sulphide copper	0.718
Oxidized copper (principally silicate)	0.137
Concentrate shipped, copper	34.257
Mill tailing, copper	0.196
Sulphide copper	0.097
Oxidized copper	0.099
Ratio of concentration	51.58:1
Recovery, total copper	77.64
Sulphide copper	87.4

At the time of my visit, the concentrate had been raised to about 40 per cent, and the tailing was about 0.16.

One of the things that impresses the visitor most in this district is the great growth of the tailing piles in the last few years. With some 25,000 tons of ore a day being treated by the two companies, it is evident that it will not take long to accumulate tailing dumps of considerable size. Last year the Miami company spent $123,000 on constructing a new tailing-disposal plant, and another large sum has been required this year. This plant has just been completed and the tailings are now being transported to a new tailing dam about 3 miles from the mill and having storage capacity for 100,000,000 tons of tailings. In connection with the new tailing system, an immense (325 ft. diameter) Dorr thickener is installed near the mill, to thicken the tailing from 27 to 45 per cent solids before they are sent to the new dam.

Production of Abrasives in 1927

THE production of miscellaneous natural abrasives sold by producers in the United States in 1927, as reported by the U. S. Bureau of Mines, is shown in the following table:

Abrasive	1927 Short Tons	1927 Value
Emery	506	$ 5,855
Garnet	6,939	573,525
Grinding pebbles and tube-mill lining	3,342	46,856
Grindstones	23,682	659,007
Millstones, chasers and dragstones	.....	35,438
Oilstones, whetstones, hones, scythestones, and rubbing stones	932	233,080
Pulpstones	8,249	895,743
Pumice	53,298	221,481
Tripoli	26,099	447,068

Artificial abrasives sold during the year included 26,289 tons of carbides, valued at $2,603,571; 50,973 tons of aluminum oxides, valued at $4,516,637, and 13,364 tons of metallic abrasives, valued at $839,683.

USEFUL OPERATING IDEAS

Gunite Lining for Converter Flue and Dust Chamber

By E. H. Oneal

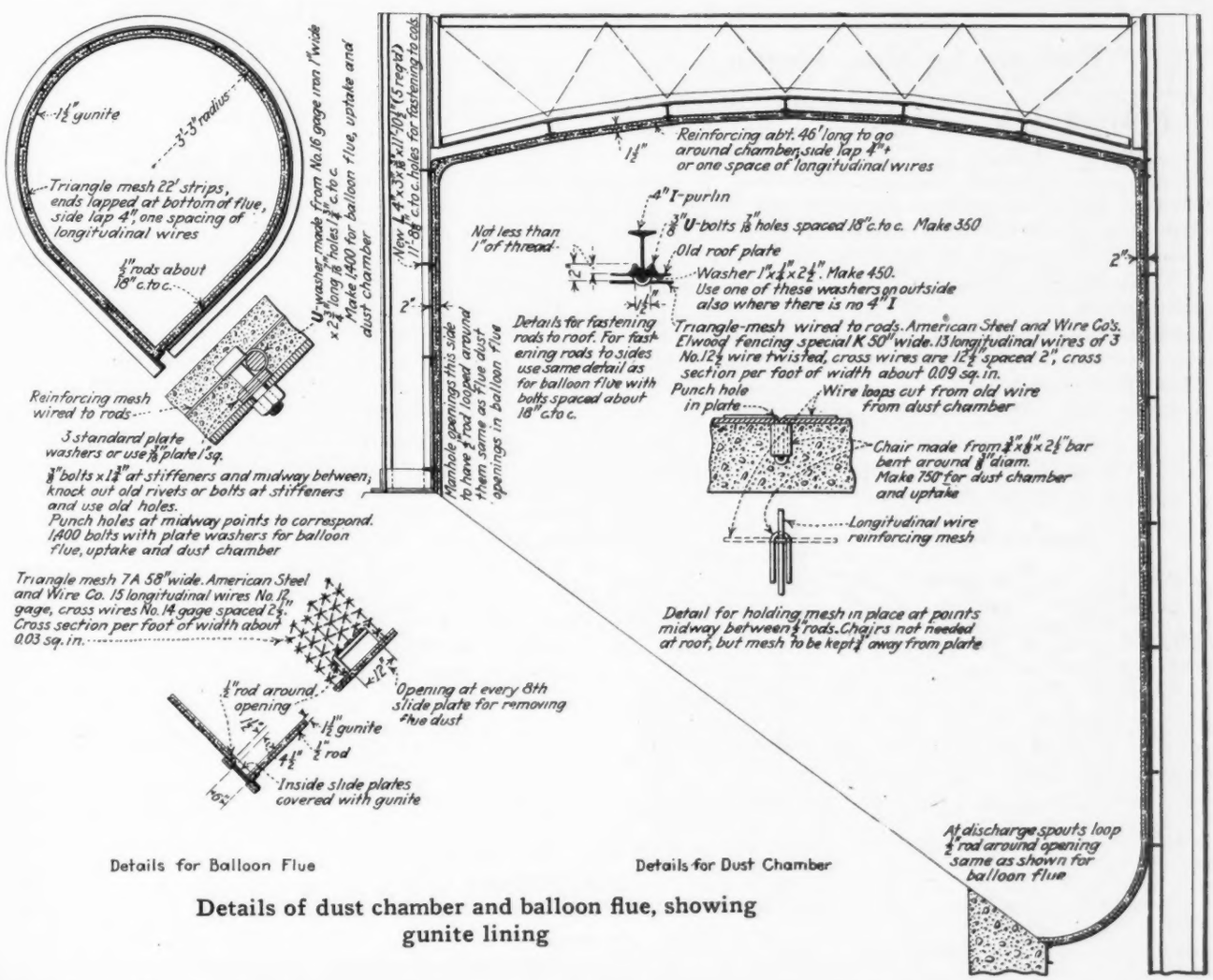
IDEA No. 1

WHEN preparing to resume operations at the plant of the Old Dominion company, Globe, Ariz., after the shutdown of 1921, the question of repairing the converter balloon flue and dust chamber came up. The balloon flue is 6½ ft. in diameter and a little over 100 ft. long, made of steel plate with angle stiffeners and with gates at the bottom for removing the dust. It is connected to the dust chamber by a plate steel uptake. The dust chamber is about 17½ ft. wide by about 75 ft. long, with steel plate roof and sides; the larger portion of the floor is the natural rock of the hillside on which the chamber is built.

The steel plate of these structures was badly corroded, many large holes being eaten through. Estimates were made for replacing the steel plate and the plans drawn. Estimates were also made for repairing with gunite. The latter course was decided upon.

The dust chamber and flue were thoroughly cleaned; the old chains and wires were removed, as it was thought that the gases passing through the dust chamber would be slowed down sufficiently to allow most of the dust to settle out without their aid. Holes in the steel plate were covered with light galvanized iron as a backing for the gunite. U-bolts through the shell carried ½-in. rods, centered about ¾ in. from the inside of the shell; washers were used to effect proper spacing. To these rods the reinforcing mesh was wired. Fencing that was on hand was used for this purpose.

Creek sand, largely quartz, screened to minus ¼ in., was used in making the gunite mixture. This was three and one-half parts sand to one part cement. It was mixed in a concrete mixer and fed continuously to the


1½" gunite
3'-3" radius
Triangle mesh 22' strips, ends lapped at bottom of flue, side lap 4", one spacing of longitudinal wires
½" rods about 18" c. to c.
Reinforcing mesh wired to rods
3 standard plate washers or use ⅜" plate 1" sq.
⅜" bolts x 1¾" at stiffeners and midway between; knock out old rivets or bolts at stiffeners and use old holes.
Punch holes at midway points to correspond.
1,400 bolts with plate washers for balloon flue, uptake and dust chamber
U-washer made from No. 16 gage iron 1" wide x 2¾" long, ⅜" holes 1¼" c. to c. Make 1,400 for balloon flue, uptake and dust chamber
New L 4" x 3½" x ⅜" x 11'-0" c. to c. holes for fastening to cols. (5 reqd.)
Manhole openings this side to have ¾" rod looped around them same as flue dust openings in balloon flue
Triangle mesh 7A 58" wide. American Steel and Wire Co. 15 longitudinal wires No. 12½ gage, cross wires No. 14 gage spaced 2½". Cross section per foot of width about 0.03 sq. in.
½" rod around opening
Opening at every 8th slide plate for removing flue dust
1½" gunite
½" rod
Inside slide plates covered with gunite
Details for Balloon Flue
1½"
Reinforcing abt. 46' long to go around chamber, side lap 4" + or one space of longitudinal wires
4" I-purlin
⅜" U-bolts ⅞" holes spaced 18" c. to c. Make 350
Not less than 1" of thread
Old roof plate
Washer 1" x ¼" x 2½". Make 450. Use one of these washers on outside also where there is no 4" I
2"
½"
Details for fastening rods to roof. For fastening rods to sides use same detail as for balloon flue with bolts spaced about 18" c. to c.
Triangle-mesh wired to rods. American Steel and Wire Co's. Elwood fencing special K 50" wide. 13 longitudinal wires of 3 No. 12½ wire twisted, cross wires are 12½ gage spaced 2", cross section per foot of width about 0.09 sq. in.
Punch hole in plate
Wire loops cut from old wire from dust chamber
Chair made from ¾" x ⅛" x 2½" bar bent around ⅜" diam. Make 150 for dust chamber and uptake
Longitudinal wire reinforcing mesh
Detail for holding mesh in place at points midway between ½" rods. Chairs not needed at roof, but mesh to be kept ¾" away from plate
At discharge spouts loop ½" rod around opening same as shown for balloon flue
Details for Dust Chamber

Details of dust chamber and balloon flue, showing gunite lining

gunite machine. The machine was operated by a man who had had considerable experience with underground gunite work. The gunite was built up in layers to the minimum thickness shown on the drawing, but actually it averaged somewhat more. Though allowable in most gunite specifications, no rebound was used, as it was considered too dirty. The loss ran between one-third and one-fourth of the sand. The gunite was kept thoroughly wet for two weeks while curing. Some few shrinkage cracks occurred, but not of sufficient size to allow leakage, and these soon covered with dust.

The total area gunited was 7,500 sq.ft. The cost was $0.387 per square foot, divided as follows: Cleaning and patching, $0.076; reinforcement, $0.118; sand, $0.023; and guniting, including cost of cement, $0.170. This also includes about $35.54 per cubic yard of gunite mixed or one-third to one-half more per cubic yard in place.

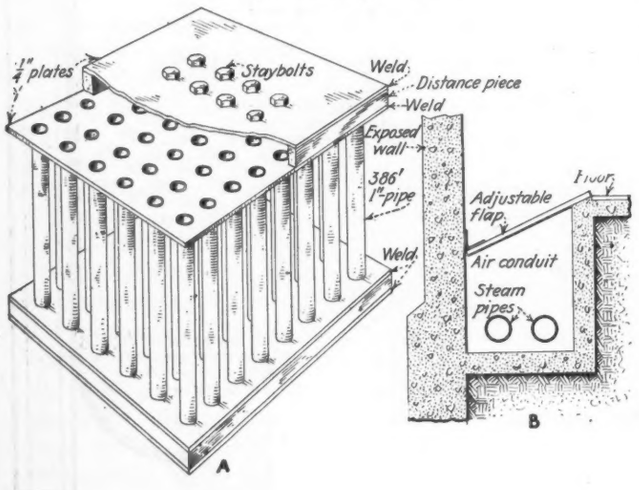
For almost three years after the gunite was placed the flue and chamber were in use before the smelter was closed down, and they have now stood another three years out of service. Not only was the gunite subject to the usual high temperatures of converter gases, but also to a daily expansion and contraction, owing to part-time operation. The gunite is still in excellent condition except for a few square feet that have spalled to a depth of about ¼ in.; possibly this is the last layer in the building-up process. This is probably due more to our inexperience in this kind of work than to any inherent fault in the gunite lining.

Radiator for Shop Heating

IDEA No. 2

AT THE mine surface plant of the Hecla Mining Company at Burke, Idaho, J. B. Sloan, master mechanic, designed and had constructed a simple form of heater or radiator which has proved effective. The radiator consists of a number of 1-in. pipes, each about 2 ft. long, which are welded to ¼-in. plates at either end. A common steam space is formed by additional plates which are also welded and provided with several small staybolts as shown in the accompanying sketch (*A*). An inlet pipe supplies steam at 15-lb. pressure and an outlet pipe carries away the water of condensation to a steam trap. The radiator is placed where air can circulate freely through the nest of pipes, or a fan can be operated so as to circulate the air through the radiator.

"A," radiator for shop heating. "B," steam pipes laid in conduit for heating shop air



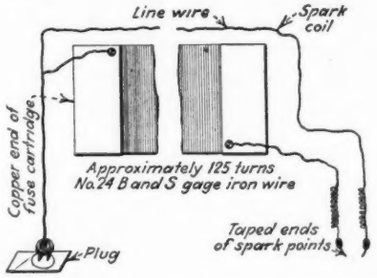
In another part of the shop a conduit is built below the floor level and upon the exposed side of the building, the building wall serving as one side of the conduit. The top of the conduit at floor level is closed by wooden flaps, which are hinged and can be opened partially or completely. Steam pipes are placed in the bottom of the conduit and a fan forces air through it. The warm air is discharged through the open flaps, one or more of which are partly opened in the room to be heated. The accompanying sketch (*B*) shows the arrangement of the steam pipes.

An Electric Match

IDEA No. 3

W. A. ERNST, chief chemist of the South Dakota State Cement Plant, at Rapid City, describes, in a recent issue of *Rock Products,* a handy substitute for matches that he made with the spark coil shown in the accompanying illustration. Primarily this coil was intended as a source of ignition when using a Parr calorimeter for determining the B.t.u. in coal. For the secondary purpose of serving as a match, another set of wires was attached, which were used for lighting blast lamps and the like. By running a general wire from the coil around the laboratory and tapping in wherever a burner is located, the coil could be used for almost any condition.

Spark coil used as electric match


Line wire
Spark coil
Copper end of fuse cartridge
Approximately 125 turns No.24 B and S gage iron wire
Taped ends of spark points
Plug

The coil as shown is simply an old fuse cartridge, 1¾ in. in diameter and 6¾ in. long, wrapped with approximately 125 turns of fine iron wire (according to the intensity of spark desired) and then covered with shellac. Wires can then be attached to the terminal screws and conducted to any desirable place. These leads are nothing more than ordinary copper lamp cord, composed of two wires. In the sketch one of these has been cut to make possible insertion of the resistance coil. The other is the line wire. By passing this through a fuse block, it is possible to guard against short circuit. This, however, is something that is usually taken care of by the fuses at the electric meters. The spark points are taped to protect the operator from shock. The coil may be plugged in on any light or wall socket.

Utilizing Water in Mines

IDEA No. 4

WHERE it is necessary to drop water 100 ft. or more to a pumping level it can be utilized to furnish power by conducting it through tight pipes instead of allowing it to find its course through stopes and raises. One mine uses such power to drive a fan, and another drives a generator which supplies electric light to several stations of the mine.

COMMENT AND CRITICISM

Blue-Sky Legislation

THE EDITOR:

Sir—The greatest surprise I ever had was when I read in the July 7 issue of *Engineering and Mining Journal* the words "Just what restrictions are meant?"

You must know that the blue-sky laws, which have almost ruined the development of prospects and cut down such operations almost entirely in the United States, were the restrictions meant.

C. W. GAMMON.

New York, N. Y.

THE EDITOR:

Sir—In the good old days, when no blue-sky commissions dared meddle with "legitimate graft," any smooth promoter could find a few "good" gold mines in California that could be bought for $1,000 to $5,000 apiece and sold to the "sucker" public for $100,000 to $200,000 apiece. It was only necessary to incorporate in Nevada or Arizona for one or two million shares, par value, 10c. each, and then unload the stock on the public.

The blue-sky commission of California has interfered with the crooked promoter's game, but every now and then, while the commission is chasing some honest promoter or prospector through the tall grass with hue and cry, the dishonest promoter or broker gets a chance to garner a few shekels.

The best we can hope for is that the blue-sky commissions will not kill too many honest promoters, honest prospectors, and honest mine operators while they are discharging their blunderbusses at the crooked promoters and crooked bucket shops.

All this talk about the blue-sky commission of California having killed mining in California is pure nonsense. California as a mining state has had her day. Of course, there is one good mine, the Walker copper mine, and a few gold mines, like the Empire and North Star, here in Grass Valley; but, speaking by and large, mining is at a low ebb in California, simply because the gold and silver and lead and zinc and copper are not here in paying quantities.

The dredges are making money handling sand and gravel that average 6 to 10c. per ton. The hydraulic miners could handle a few hundred million tons of "dirt" that might average 10c. per ton, but could they make any profit worth mentioning?

My friend Mr. James D. Stewart published in *E. & M. J.* of June 9 one of the ablest articles ever written on the subject, and every one interested should preserve it and study it carefully. The only point open to question is his implication that the hydraulic miner could make "oodles" of money if he could have everything his own way.

JOHN G. SNYDER.

Grass Valley, Calif.

Art vs. Science in Southern Oregon

THE EDITOR:

Sir—You are quite correct in stating that the white-metal boom in southern Oregon is not yet over. According to newspaper reports, Professor Newton, who has not found any tin ore in southern Oregon, was asked to resign, and a certain mining fraternity rejoices.

Notwithstanding the inability of the Bureau of Mines in Washington, or other capable assayers and chemists, to find white metal or tin by the standard methods of assay or chemical analysis, *the white metal is produced nevertheless.* The production of white metal or tin is not a science; it is an art, developed to perfection in Grants Pass, Ore. There are perhaps one hundred or more people in southern Oregon able to produce white metal regularly from nearly every kind of ore by the "kitchen-stove method," and half a dozen artists manufacture white metal in small furnaces. One can even buy rings made from this mystery metal.

A few months before the Portland Land Office sent a few men for a few months' useless investigations at Grants Pass, I published a recipe which will enable any layman to find tin in any ore. This was the advice:

1. Never consult any competent assayer or chemist.

2. Make a fire in the kitchen stove; put a few newspapers, a few dozen yeastcake wrappers, and a few tobacco wrappers with any kind of fuel, in the stove; place a frying pan with hamburger in the pan and place the ore in the refrigerator. After cooling, pan the ashes. If onions are used with the hamburger the white metal is tin; if garlic is used the white metal is platinum.

After publication of this white-metal test, certain tin artists announced that they could produce white metal in a kitchen stove even if the ashpan were cleaned carefully and contamination with tinfoil eliminated. And they did. Perfectly clean pieces of wood were ignited; the ore was placed on the top of the wood, and soon "white metal" dropped through the grate. There you are. However, an artist can do this only with his own wood. It fails entirely with ordinary wood. The process is simple enough. One drills a small hole into the wood, inserts solder wire, and seals the holes up carefully.

Furnaces operated with oil burners produced "tin," and nothing but ore was charged into the furnace with the exception of the oil coming through the nozzle and the tin salts which had been added to the oil.

Of course the presence of tin can be confirmed by "assays." There are plenty of artists in the United States who can find gold, platinum, tin, and other metals where the ordinary college-trained man finds nothing. On the basis of one single assay a few men went to work and constructed several miles of roads, started mining, put up a grinding mill and a concentrating table, and after a few months found, of course, no gold, platinum, or tin. The ore was a fairly pure pyrite.

A barber needs a license in Oregon, but an assayer can put up shop any time, anywhere, and prospectors of a kind like a certificate showing high-grade ore if some one will furnish it.

If all the money and energy spent on tin claims could have been concentrated on a detinning plant for tin scrap and old tin cans, we could produce real tin and would have made some progress in establishing another industry in Oregon.

We have had in southern Oregon, and have yet, time and money available for oil, tin, and platinum, but our real mineral wealth lies dormant.

GEORGE SCHUMACHER.

Medford, Ore.

Dowsing Still in Realm of Science?

THE EDITOR:

Sir—I thought that Mr. Rickard's recent review of the divining rod had at last sounded its *nunc dimittis,* at least from reasonably intelligent circles; but the quasi-scientific defense offered by your correspondent in the July 7 issue of *E. & M. J.* shows that I was in error, and that Agricola of old was more orthodox in his science on that score than some of today's scientists.

Professor D. W. Hering, in his interesting book, "Foibles and Fallacies of Science," devotes some eighteen pages to the divining rod. The novel feature of his presentation discusses why the rod turns in the hands of the diviner. The turning of the rod, he claims, is

not mysterious but perfectly good mechanics.

The rod is held with the hands turned up and so that the hands on the two branches of the fork give opposite thrusts on the head or point, and the whole system of the rod, the wrists and arms of the dowser are thus in a state of unstable equilibrium. When the tension is relaxed or becomes unequal either through tiring of the wrists or when the dowser's attention is distracted momentarily when passing over an obstacle or rough ground, so that any part of the system of forces thus falls outside the neutral plane, the equilibrium is destroyed and the more vigorously the rod is clutched the more violent will be its dip; and, presto! a new bonanza is found!

Let us whisper it, that some of the new ultra-scientific prospecting methods impose almost as severe a strain on our credulity, and they have not the rod's mitigating halo of antiquity, nor can you accompany the use of hyperbolic logarithms with alluring incantations without the risk of appearing incongruous. Still perhaps that refinement will come, and perhaps it is not so incongruous. EDWIN C. HOLDER.

Baltimore, Md.

Theory of Mine Sampling

The following reply by Dr. Thomas T. Read to comments on an article written by him and published in the April 7 issue of *Engineering and Mining Journal* appears in the current issue of *Mining and Metallurgy:*

"In commenting on a recent article by myself on the theory of sampling[1], George J. Bancroft[2] has suggested that I might have drawn more sharply the distinction between ore sampling and mine sampling. Doubtless this is true, since I did not attempt to make the distinction in the article referred to; hence I will here endeavor, so far as it lies in me, to make the distinction more clear.

The difference between ore sampling and mine sampling is fundamental. In the former the sampler is dealing with definite masses; in the latter he is dealing with indefinite ones. It is possible to count the number of rabbits in a pen and determine how many white rabbits there are among them, but to estimate the number of white rabbits in a field a mile square is an entirely different undertaking. In sampling a mass of ore (that has been moved from its original place) there is a definite tonnage to be dealt with, just as in the pen there are a definite number of rabbits to be counted. D. W. Brunton has clearly explained the two fundamentals of sampling a definite mass of this kind; (1) handle the material so that no segregation occurs, (2) crush the material so that after each division there will be as many particles as there were in the beginning. The theory is simple; it is only the practical application of it that is difficult.

"Where the extent of the mass to be sampled is not known the theory is far from simple. Let me use another homely illustration. Suppose it is desired to estimate the percentage of horse-drawn vehicles in a fair-sized city. This would have to be done by sampling, probably by selecting certain blocks and counting the number that pass in a measured interval of time. The practical execution of this task will be exceedingly difficult. If main concrete highways are selected the proportion will be different than on unpaved side streets, the time of day selected will make a difference, and it will also be found that the city shades imperceptibly out into the country so that, except on the artificial basis of a political boundary, no one can say where the city ends. The results shown in the samples will vary according to the judgment shown by the sampler. Mathematical calculations as to the probable error in a series of samples may be rendered absurd because the sampler chose the milkman's hour for taking his samples or took too many samples on the side streets in proportion to the main highways.

Sampling in a mine is even more difficult. If orebodies were symmetrical lodes with clearly defined walls, like a coal seam, even then it would be difficult because the dissemination of the valuable mineral in the lodes is usually variable, but when to this is added variability in size and shape it becomes bafflingly complex. It would seem to me that the sampler must have some theory as to the size and extent of the orebody to guide him, and the trained eye, as Mr. Bancroft expresses it, is probably the best practical guide. Our chemistry professor, in undergraduate days, in telling us how to do chemical analysis, used to say to not use too much of a reagent, nor yet too little, but to use just enough and then we would get it right the first time. The practical application of theory often cannot be made more definite than that.

"I agree with Mr. Bancroft that the arbitrary rejection of high samples is incorrect; if they occur they must be reckoned with, and it must be considered what they represent. This may be difficult to ascertain, but it should be done. Going back to our example, if the vehicle sampler happened on a funeral procession where the vehicles were all horse-drawn he would not be justified in simply throwing that count out. Some weight must be given to it, and the determining of how much is where trained judgment has to come into play.

"What we are after is the finding of the correct result, and if arbitrary rules and procedure interfere with getting the right result they must be suitably modified. A hunter would not use bird shot on an elephant, or big caliber bullets on quail, and the mine sampler similarly needs to modify his procedure according to circumstances. In the words of my old professor, if he does it just right he will get it right the first time."

[1] "Theory of Sampling." *Engineering and Mining Journal*, April 7, 1928.

[2] "Eye Sampling and Its Merits." *Engineering and Mining Journal*, May 26, 1928.

Selective and Differential Flotation Again

THE EDITOR:

Sir—A few years ago I didn't care particularly whether you used the term "selective" or "differential" in describing the process of flotation whereby two separate shipping concentrates are made, but I would like to put in a modest plea for consistency in this respect. My notion is that if the *E. & M. J.* will uniformly use any mining or milling term week in and week out, and persist in it, the industry finally will come to accept it. The "power of the press" or the "influence of repetition on the subconscious," or something like that, may be the reason; but just the same it will prove true. Now, I have noticed the word "differential" used two or three times lately, and I have had to stop and scratch my head, because I had almost been weaned away from that term. Please stick to "selective" for the benefit of us benighted ones in the mining camps who like to read the articles on flotation, but don't like our trains of thought broken by studying over the terminology used. FLOATER.

Somewhere in Arizona.

[We regret that we have not been consistent in this respect, but it is difficult, in the hurried work of editing news articles and such material particularly, to pay due attention to fine points. Flotation terminology is an empirical matter; our announced suggestion was to employ the term "selective flotation" for the process in which two or more concentrates were made; "differential flotation" when only one concentrate was made, but control was exercised designed to drop some of the normally floatable minerals, such as pyrite, with the gangue; and "straight flotation" or "bulk flotation" when all the floatable (generally sulphide) minerals were separated as one concentrate, only the gangue going into the tailing.—THE EDITOR.]

Consultation

Bibliography of Geology of Tintic Mining District

"I would like to secure a list of publications dealing with geological features of the Tintic, Utah, mining district. Can you give me such a list?

The following publications relate to the subject you mention:

Professional Paper 107 of the U. S. Geological Survey, "Geology and Ore Deposits of the Tintic Mining District, Utah." By Waldemar Lindgren and G. F. Loughlin. A copy of this publication may be obtained for 70c. from the Superintendent of Documents, Government Printing Office, Washington, D. C.

The following papers appear in the Transactions of the American Institute of Mining and Metallurgical Engineers:

1. "Geology of the Tintic District," Vol. LXII, 677.

2. "Geology of Ore Deposits of the Tintic District," Vol. LIV, 342, 353, 355.

The following papers have appeared in the magazine *Economic Geology* published at Lancaster, Pa.:

1. "The Oxidized Zinc Ores of the Tintic District," Vol. IX, 1.

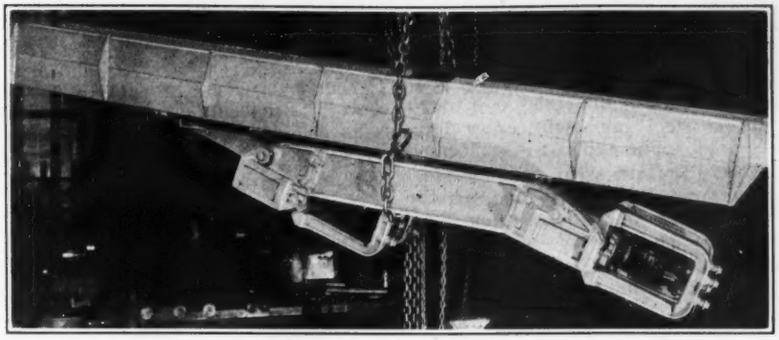
2. "Processes of Mineralization and Enrichment in the Tintic District." By Waldemar Lindgren. Vol. X, 225.

3. "Tintic District Geology," Vol. XI, 286.

"Mining Camps of North America; Tintic, Utah: Active Since 1870." *Engineering and Mining Journal*, March 1, 1924; pp. 355-61.

INDUSTRIAL PROGRESS

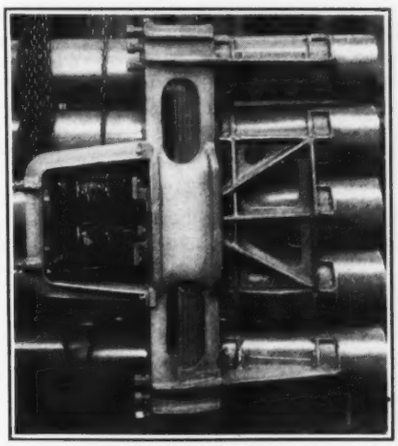
The Equipment Review



Trough type of vibrating conveyor, intended as a feeder for rolls, ball mills and other equipment

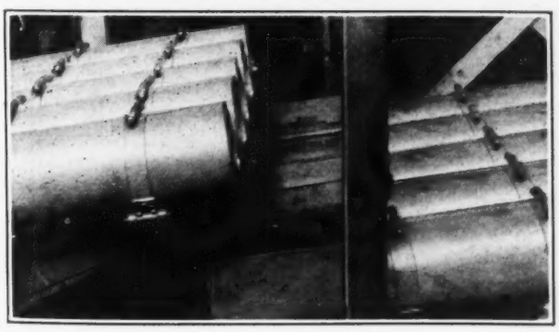
A VIBRATING CONVEYOR adaptable as a feeder for rolls, ball mills, and other ore-dressing equipment in the metal-mining industry has recently been announced by the Traylor Vibrator Company, of Denver. Both tube and trough type units are being manufactured, but the latter is expected to have wider application in the milling of metalliferous ores. Both types are shown in the accompanying illustrations.

The electrical vibrating mechanism is similar in action to that with which the company's screens are equipped. Vibration of a sine wave character is applied at an angle to the conveyor, the downward component being slightly more rapid in action than the fall of the particles on the conveyor caused by the force of gravity. As a result there is a constant forward motion of the particles on the conveyor. Tests have shown that various materials, varying from dust to 2 in. in maximum diameter, may be moved at a rate of 65 ft. a minute horizontally, and at about half this rate up a 20-deg. slope. Capacities varied from 60 tons an hour, with the conveyor in a horizontal position, to 34 tons an hour with the unit set at a 20-deg. angle above the horizontal. Operation of the conveyor is practically noiseless, and the capacity, or speed of travel of material on it, may be closely controlled by means of a rheostat furnished with the vibrating mechanism. The tube-type machine shown consists of five 10-in. tubes and has approximately 75 tons' capacity up 7 deg. This can be increased 15 per cent on the horizontal. Its operation is practically noiseless, and it has no moving parts. Material of practically any temperature can be run through, as it is all steel. It can probably be built in units of 15-ft. lengths, and where the haul is longer than that, one or more units would be required.



Under side of a tube-type conveyor unit

Conveyors of the trough type are being manufactured in widths of 20, 36, and 48 in., and in lengths up to 20 ft. Installations are now under practical test at several milling plants in the metal mining industry.

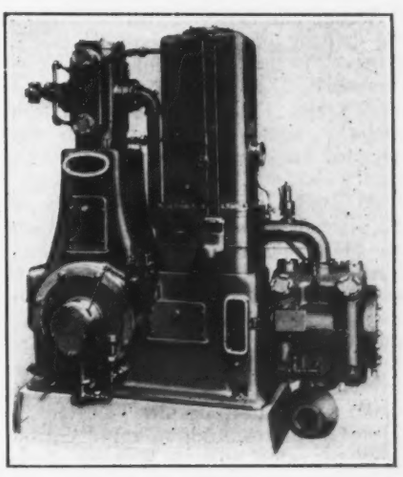


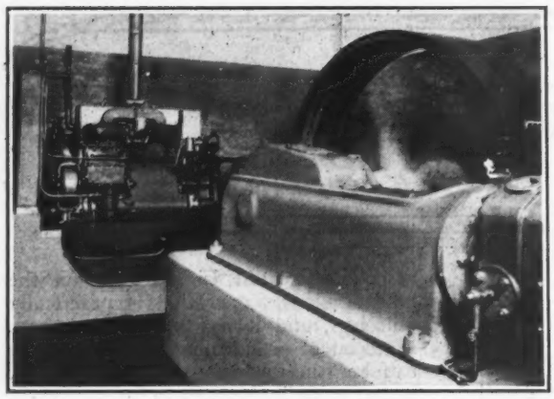
At the left—A tube-type vibrating conveyor as actually installed

Compressors

Another interesting piece of equipment is the new small-sized, angle-compound compressor introduced by the Sullivan Machinery Company, 122 South Michigan Ave., Chicago. These are built on the same principle and design as the larger angle-compound machines turned out by the company, and range in capacity as small as 300 cu.ft. displacement. Among the advantages afforded by the angle-compound type of construction are compactness, balance of reciprocating parts, freedom from vibration, low power consumption, and smooth operation. The photograph shows a machine of this type (Model WJ-3) from the intake side. The details wherein its construction differs from that of the larger angle-compound compressors are set forth in Bulletin 83-K, issued by the company. A substantial crosshead, connecting rod, and crankshaft are provided. The standard pulley wheel supplied with the belt-driven type compressor is of the proper weight and size for either short belt or long belt drives.

The angle-compound compressor may now be had in a new small size





Two-stage horizontal air compressor of 1,000 cu.ft. capacity, driven by a 92-hp. Diesel engine

This pulley may be readily removed and a sheave substituted to permit the use of Texrope drive. Cylinder barrels and heads are completely surrounded by water jackets to reduce the heat of compression, and the water spaces are provided with drain cocks. Inlet and discharge valves are of the wafer type. The intercooler is of the vertical, two-pass type, especially designed to withstand the pressures encountered and at the same time serving to cool the air from the low-pressure cylinder. Air under pressure is conducted through copper cooling tubes and water is circulated around them. The tubes are expanded and rolled tight into steel header plates. The intercooler is mounted on the main compressor frame in the argle between the horizontal and vertical cylinders. It may be readily removed for inspection or to clean the tubes. A pop safety valve of ample size is provided. Both cylinders are lubricated from a two-feed force-feed oil pump which is driven from the crankshaft.

An interesting application of Diesel power is shown in another illustration. Here a two-stage 16x10x14 in. air compressor of the horizontal type is seen driven by a four-cylinder Buda-M.A.N. Diesel engine of 6-in. bore and 8-in. stroke, operating at 950 r.p.m. The engine is connected with the compressor by means of a short belt and idler pulley. This compressor delivers 400 cu.ft. of air per minute at 130-lb. pressure. The engine is of the full Diesel type, developing 92 hp. at 1,000 r.p.m.

Rock Drills

Among the drills recently introduced for drifting or tunnel work is the D8 drifter of the Cleveland Rock Drill Company, 3734 East 78th St., Cleveland, Ohio. This machine is a light, powerful, simply built stream-line drill, intended for operation from a tripod or quarry bar. It weighs 135 lb. with a 30-in. feed. Its over-all length is 46¼ in. The diameter of the cylinder is 3⅜ in., the stroke 2¼ in. The drill has a ¾ in. air connection and takes a ⅜ in. water hose. It can be supplied with chucks for all standard sizes of round lugged steel and for the several shapes of plain shanks. A valve of the live-air thrown type is used, giving a high-piston speed, a strong blow, and powerful rotation, resulting in rapid cutting. It is provided with a blowing device controlled by the throttle lever. The principal feature of the chuck is a tough manganese steel jaw with extra long driving lugs. The exhaust is so located as not to interfere with the operator. Oil reservoirs are provided over the valve head and over the spacer. An effective air cushion is provided both front and back, eliminating breakage of the parts. The machine has a larger rifle bar than ordinarily found in one-man drifters, and the pawls are longer; also the rifle nut and chuck nut. Furthermore, it has an effective air screen 2¾ in. diameter, which protects the internal parts against grit without interfering with the flow of air. The exhaust outlets are so located as to avoid the formation of ice in ports, and so as not to blow out the lights or stir up dust about the machine man.

The Keystone Driller Company, of Joplin, is reported to have developed a new all-steel churn drill, on which a wire rope has been used successfully. Among the refinements added are roller bearings and a Texrope drive.

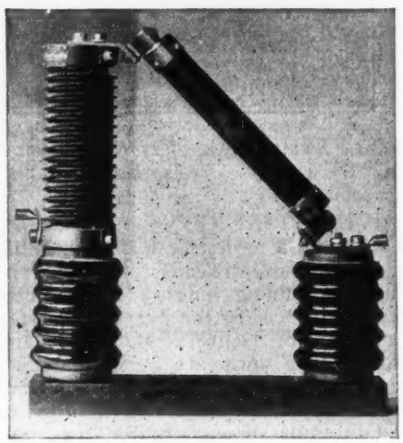
Power Shovels

The new 12-yd. shovel recently installed by the Northern Illinois Coal Corporation for stripping purposes near Wilmington, Ill., is shown in the accompanying cut. It was built by the Marion Steam Shovel Company. A description of this machine has already been published in these pages. Prior to the erection of this shovel (Type 5480) the largest coal-stripping unit had been the Marion Type 350, which carried an 8-cu.yd. dipper.

Electrical Equipment

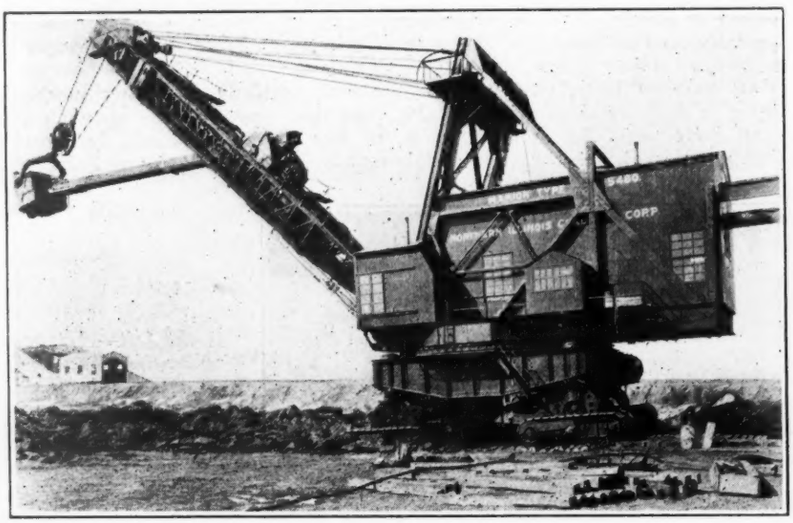
Overload Device—Westinghouse has developed a new thermal overload device which retains calibration and automatically permits the safe overload capacity of the motor to be fully utilized. This is intended to replace the makeshift overcurrent relay so often used for this work. The device follows the heating curve of the motor. This means that the latter will not shut down instantly under high but harmless overcurrent demands.

Increasing A.C. Transmission Capacity—Transmission characteristics closely approaching those of high-voltage direct current were realized for the first time recently with the installation by the General Electric Company of three series capacitors on a tie-line operated by the New York Power & Light Corporation at Ballston Spa, N. Y. The capacitors, connected directly in series with a 33,000-volt, 7,500-kva. line running from Amsterdam to Ballston sub-



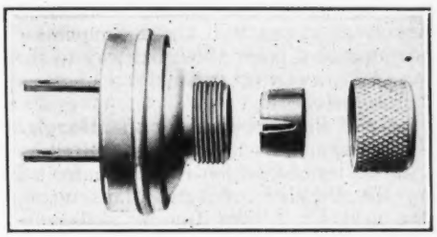
New transformer fuse and wire-wound resistor. See opposite page

The 12-yd. stripping shovel recently placed in commission in the Middle West



station, compensate completely for transformer and line reactance at all loads. The electrical effect is said to be equivalent to placing the Ballston substation in the yard of the Amsterdam generating station 20 miles away. In this device the ohmic resistance of the intervening line is all that remains.

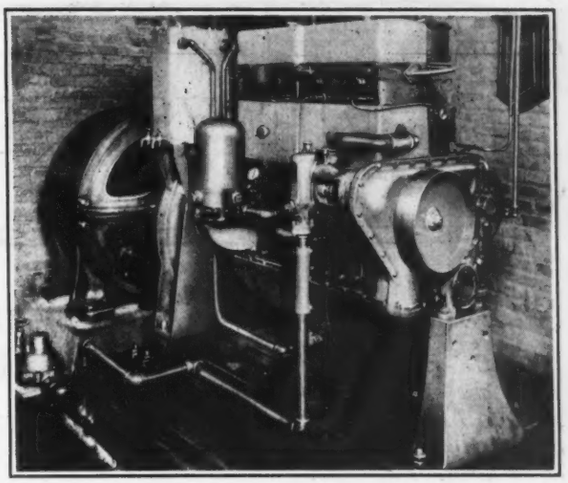
The electrical profession has long realized that direct-current transmission at high voltages would give ideal performance characteristics and would permit large amounts of power to be sent over great distances at an expense far less than for alternating current. Direct current, however, cannot be generated or utilized successfully at high voltage, and no device has ever been available which could economically perform the transformation in voltage required if high-tension direct-current transmission were to be used with low-voltage generators and load. The series capacitor, however, is a solution of the problem from another angle, for, instead of making d.c. transmission possible, it has eliminated some of the most serious limitations of a.c. transmission. It does this by nullifying the reactance of the transmission line and of the equipment interposed in the line, such as transformers.



A plug cap with an improved cord grip

Fuse and Resistor—Westinghouse has also announced the introduction of a so-called Type H combination potential transformer fuse and wire-wound resistor for 2,500- to 25,000-volt service. It is intended for indoor application and can be mounted on any flat surface or upon 1¼-in. pipe. This resistor is placed in series with the fuses, and effectively limits the current in case of a short circuit. This permits the use of potential transformer fuses on any circuit regardless of its short-circuit amperes, provided that the voltage rating of this system is not more than that of the fuses and the resistors. The resistors are made of coiled nichrome wire wound in the grooves of a heavy wet-process porcelain tube. They are combined with fuse and fuse mountings and insulators as shown in the accompanying cut. The resistor may be mounted in line with the insulators, perpendicular to them as shown.

One of the accompanying cuts shows an unbreakable attachment plug cap with improved type of cord grip, recently introduced by the Cutler-Hammer Manufacturing Company, 128 12th St., Milwaukee. The cord grip acts as a positive strain relief and is designed particularly to lessen short-circuit hazards. The knurled collar wedges a fiber bushing tightly against the cord, insuring a firm grip on the latter at all times.

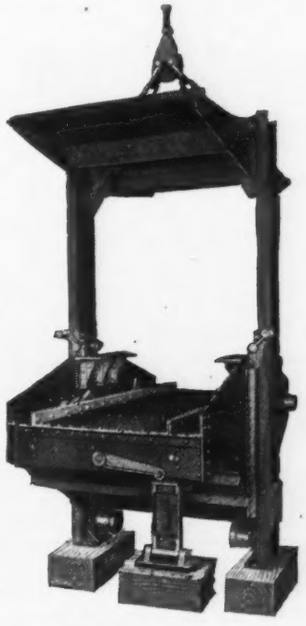


A Diesel engine-driven d.c. generator for supplying traveling cranes

Cranes, Hoists

As a source of direct-current supply for overhead traveling cranes the Buda Company, of Harvey, Ill., has introduced an engine-driven generating set such as that shown in one of the accompanying illustrations. This set consists of a Buda-M.A.N. Diesel engine direct-connected to a 65-kw. 900-r.p.m. 250-volt, 260-amp. generator. The demand on this set is continuous, the load fluctuating from 1 to 300 amp. and often increasing instantaneously from zero to maximum. The engine itself is of the four-stroke cycle type, and fuel is injected without the use of an air compressor. A self-starter is provided. No heating devices are required. Lower grades of fuel oil are used. The unit occupies a floor space of 5x10 ft. It may also be had in 50, 80, and 100 kw. sizes.

Chain Hoist—A new direct differential hoist, known as the "Blue Boy," is being manufactured by the Chisholm-Moore Hoist Corporation, of Cleveland. Greater efficiency has been obtained in the design, and a Hercules Inswell electric welded load chain is used, this affording greater safety.



A self-dumping cage

Self-Dumping Cage—The Olson self-dumping cage, which is widely used in the coal industry and but little known in the metal-mining fields, is shown in the accompanying cut. It is made by the Eagle Iron Works, of Des Moines, Iowa. The latest improved model is so designed that the empty car is automatically released as the cage lands at the shaft bottom and is pushed off by the loaded car as the latter enters the cage, the loaded car at the same time setting the stop which holds it on the cage. There are no obstructions on the cage platform or in the tracks at the bottom of the shaft for men to slip on. This type has been especially designed for use with automatic cagers and feeders. Each cage is built to meet individual requirements of each particular installation.

A new one-man crawler crane in ½-, ¾-, and 1-yd. sizes has been introduced by the H. D. Conkey & Company, of Mendota, Ill. It is operated either by electric motor or gasoline engine.

A Correction

Oliver United Filters, Inc., requests that all communications regarding either Oliver or United filters and equipment be sent to the same office as its customers have previously been dealing with. This will supersede the notice published in the *E. & M. J.* of July 7.

BULLETINS

COMPRESSORS—R. Planche & Company, Villefranche sur Saone, Rhone, France. A 40-page bulletin presenting a comparative study of the various methods of compressing air. In it are discussed reciprocating compressors, rotary slider compressors, and the Planche rotary compressor.

SCREENS — The Deister Concentrator Company, Fort Wayne, Ind. Bulletin No. 12-D. The Leahy No-blind vibrating system.

CRUSHERS—Symons Brothers Company, 111 West Washington Street, Chicago. The Symons cone crusher.

NEWS OF THE WEEK

Summary

TECK-Hughes Gold, in Kirkland Lake district, plans to sink a shaft to 7,000 ft., rivaling the mines on the Rand in depth. Other Canadian news. Page 107.

* * *

The Deer Trail district, in Stevens County, Wash., is undergoing a renewal of mining activities after a lapse of almost 30 years. Venus Silver is erecting a 100-ton flotation mill in the district. Page 109.

* * *

Western Chihuahua and eastern Sinaloa may become mining districts of importance as a result of the comparatively cheap transportation which will be afforded by the new lines of the Kansas City, Mexico & Orient railroad, recently acquired by the Santa Fe, that are being built to Alpine, Tex. Page 111.

* * *

Report of Australian development commission states that decline in gold mining is caused largely by high production costs. Government subsidy is suggested. Page 110.

* * *

Monte Cristo Mining, one of the Julian properties in Arizona, may go into the hands of receivers as a result of the action of minority stockholders of the company. It has debts amounting to more than $450,000, compared with receipts of $14,531. Page 108.

* * *

The zinc output from Wisconsin may be considerably increased as the result of recent discoveries made near Benton. Vinegar Hill Zinc is conducting an extensive exploration program. Page 108.

* * *

The warehouse of the International Smelting Company at Miami, Ariz., was almost completely destroyed by fire on July 7. Page 110.

* * *

A new company has been formed to take over and operate the famous Horseshoe mine, in the Kalgoorlie district of Western Australia, which closed down recently. Page 111.

Various Properties Being Developed by Bradley Interests Are Progressing

Treadwell Yukon Is Making Satisfactory Separation of Complex Ore at Its Errington Mine—Construction of Concentrator at Tybo, Nev., Property Will Be Started Soon

THE various properties which the F. W. Bradley interests, of San Francisco, have under development in Ontario, Nevada, California, Idaho, and Alaska all report satisfactory progress. In addition, the new electrolytic zinc plant of Sullivan Mining, in which the Bradley interests have a share, is said to be preparing for production by September.

At Tybo, Nev., Treadwell Yukon has 100 men employed. Camp buildings are being constructed and the new vertical shaft is being raised. As soon as living accommodations have been provided, additional men will be employed and the construction of the 200-ton concentrator will be started. The new mill will be placed in close proximity to the collar of the new shaft.

Half of the pilot mill at the Errington mine, in Sudbury, Ontario, has been steadily operated, and construction of the other half is under way. Bad roads have interfered with the hauling of the second ball mill to the plant, and construction has therefore been delayed.

The situation at the mill is a new one, but the treatment of the complex sulphide ore is gradually being evolved. Already a zinc concentrate assaying 45 per cent zinc, 0.6 per cent lead, 2 per cent copper, and 3 oz. of silver per ton has been attained. The lead concentrate contains 21 per cent lead, 9 per cent copper, 7 per cent zinc, 16 oz. silver, and $3.40 in gold per ton. The copper concentrate contains 7 per cent copper, 3 per cent lead, 7 per cent zinc, 7 oz. of silver, and $2 gold per ton. It is expected that these results will be greatly improved as more experience is obtained in milling the ore.

About 380 men are employed. Of these 80 are in the mine; 130 on development; 130 on construction; 26 in milling; and about 12 on overhead. At the No. 3 shaft it is expected that the surface plant will be completed and in use by Aug. 1. The hoist and compressor have been assembled and the headframe is being constructed. In the meantime, sinking by hand is under way.

Experimental work has outlined a method for the treatment of the arsenopyrite-gold ore, at the Yellow Pine mine, in Idaho, operated by a subsidiary called Yellow Pine Mining, where 50 men are now employed. In co-operation with the Forest Service, a road is being constructed from Yellow Pine into the property, which had previously been accessible only by trail. Tractors have been found to be successful in transporting under the pioneer conditions involved. A saw mill and a compressor are now at a point about halfway to the property, awaiting the melting of snow before proceeding.

All of the properties of the Douglas Island companies have been acquired by Alaska Juneau, which is also controlled by the Bradley interests. This clears the field for Alaska Juneau, and some of the old prospects owned by the former companies are now available for exploration. It is believed that there are some good chances of developing mines similar to Alaska Juneau itself from among these prospects.

At the Sulphur Banks quicksilver property in Lake County, Calif., a 500-ton mill is being erected, which should provide sufficient concentrates and ore for present furnace installation. Because of the high moisture content, furnacing of the raw quicksilver ore involved great difficulties.

At Opalite, in southern Oregon, 100 tons of quicksilver ore is being treated per day. Sulphur Banks is producing about five flasks per day.

Moore Mining Will Explore South Jackson Vein

Moore Mining, of Jackson, Calif., will start exploration of the South Jackson vein immediately. The company will also endeavor to develop another vein, which is assumed to be a continuation of the so-called Kennedy-Argonaut vein from which the Kennedy and Argonaut mines have made most of their production. Mining and milling of ore left in the upper levels is now under way. Since March about 1,045 tons of gold ore has been milled. However, further work on the Moore vein is to be discontinued because of the prohibitive cost.

Teck-Hughes Plans to Sink Two Interior Winzes to 7,000 Ft. Depth

Proposed Workings Would Place Kirkland Lake Mine Third Among World's Deepest Mines—Progress at Flin Flon—Waite-Montgomery Prepares to Ship Ore

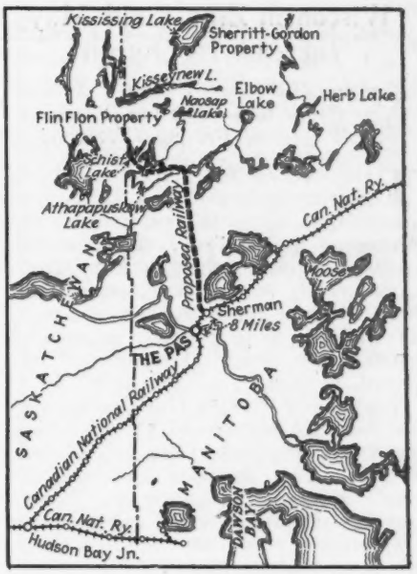
IF PLANS that have been formulated for shaft sinking at Teck-Hughes Gold, in the Kirkland Lake district, materialize, this mine will take third place among the world's deepest mines, ranking only behind the Village Deep, on the Witwatersrand, and St. John del Rey, in Brazil. At present it is expected to sink a new shaft, south of the present main shaft, to a depth of 3,600 ft. and to continue the main shaft, which now is bottomed at about 2,300 ft., to 3,000 ft. From these levels, two winzes will be sunk which will bottom at about 7,000 ft., if results meet expectations.

Teck-Hughes recently assumed the lead among the Kirkland Lake mines, from the standpoint of production, by increasing its tonnage to 950 tons a day. For some time the addition of a new 300-ton unit to the plant has been considered. If the depth program materializes, there will doubtless be still further additions to the tonnage. At present, Kirkland Lake Gold is mining from lower levels than any other of the Kirkland mines. There are rumors that this company may go to 6,000 ft. depth, mention of such a possibility having been made at the recent annual meeting of Beaver Consolidated, which controls the company.

At 7,000 ft., Teck-Hughes would be the deepest mine in North America and would only be about 200 ft. less than the Village Deep. At this time, the deepest mine in North America is probably Calumet & Hecla, in the Michigan copper district. Kennedy Mining & Milling at Jackson, Calif., is North America's deepest gold mine.

All of the grading and bridge work on the railway to the Flin Flon mine of Hudson Bay M. & S., in the Herb Lake district, Manitoba, is completed from Cranberry Portage to Flin Flon, and the arrival of the first train is expected by the end of September. The mill at the property has already begun operations. Copper, zinc, and some gold are being turned into the flotation vats. Production cannot be increased in volume much more, however, until the smelter is completed, which will not be for another year. In the meanwhile, ore is being taken out and piled in stacks until it can be handled more expeditiously than with the limited amount of crushing machinery now on the ground.

Power for operating the mine is now generated from steam, with wood as fuel, pending the completion of the electric power development at Island Falls, for which, arrangements with the Province of Saskatchewan have recently been completed.



Route of the new railroad from The Pas to Flin Flon

The main shaft of the Waite-Montgomery mine, controlled by Noranda Mines, is down to 425 ft. It is expected that shipments of ore from the property, which is in the Rouyn district, will be started this month. The ore is copper-zinc. At the 250 level a body of copper ore, proved for a length of 45 ft., was found recently which carried practically no zinc.

Jack Waite Mill in the Coeur d'Alene District Started

Golconda Lead Plant Should Start on Aug. 1—Atlas Mining Will Drift East 3,000 Ft.

THE remodeled mill of Jack Waite Consolidated Mining, now capable of handling 250 tons of ore a day, started operations on the ore from the mine in the Cœur d'Alene district, Idaho, recently. The improvements in equipment which have been made recently called for an outlay of about $60,000, according to Herman J. Rossi, president of the company. This includes, in addition to changing the mill from a 100-ton concentrator to a 250-ton flotation plant, laying of a track from the portal of the tunnel to the mill. The track supplants an old aërial tramway and is about 1,500 ft. long. Ore will be delivered to the new 300-ton ore bin at the mill end of the track by cars driven by electric motor. A Holt tractor has been purchased to keep the track clear during the winter. Concentrates will be shipped to the Bunker Hill smelter.

According to Sam H. Richardson, mining engineer, of Spokane, the underground workings at the Jack Waite are in excellent condition on the whole. The incline shaft is now down to a depth of 235 ft. below the No. 2 tunnel. In places, additional crosscutting will be necessary before the full width of the vein can be determined.

Another flotation plant which should soon be in operation in the Cœur d'Alene is the new 200-ton mill of Golconda Lead. W. A. Beaudry, manager of the company, believes it should start to handle ore on Aug. 1. The company is deriving power for its operations from the Washington Power Company's high-tension power line.

According to Conrad Wolfle, manager of the Evolution mine, in the same district, progress in sinking a new two-compartment incline shaft from the tunnel amounts to about 7 ft. a day. The shaft is now down 250 ft. from the tunnel, and is 500 ft. below the surface. Equipment at the property includes an electrically driven compressor and an air hoist.

Following a meeting of the board of directors of Atlas Mining, also a Cœur d'Alene property, on July 6, the board of directors adopted the suggestion of Oscar H. Hershey, geologist, and decided to drift east a total of 3,000 ft. to the Carbonate Hill mine. The shaft at the Carbonate Hill has been sunk 400 ft., exposing an oreshoot, 6 ft. wide. The drift from the Atlas will explore the vein 300 ft. below the bottom of the Carbonate Hill shaft.

Good Safety Record Made in Sinking Warren Shaft

IN JANUARY, 1927, the E. J. Longyear Company began sinking the new three-compartment shaft of the Phelps Dodge Corporation at the Copper Queen mine, Warren, Ariz. The shaft has now reached a depth of 2,100 ft. During this period, approximately 59,000 lb. of powder has been used, and but few changes have been made in the original shaft crew. A very low accident rate has been maintained during these eighteen months. No accidents of any kind occurred in connection with hoisting or lowering of men or material, and only three accidents were reported for the entire work, two of which were very minor, comprising only a fractured bone of the toe of one man and a bruised hand of the other. No accident occurred in connection with blasting. The work was under the supervision of George Eubank.

Golden Center to Be Reopened

The Golden Center property, at Grass Valley, Calif., idle for several years, is to be unwatered and operations are to be resumed by L. S. Wincapaw, representing the Alta Hill interests of Cooley Butler.

Wisconsin Zinc Field May Increase Its Output

Vinegar Hill Zinc Acquires Several New Properties—New Ida Blende to Drill East of Present Workings

THE outlook for the entire mining district between Hazel Green and Shullsburg, Wis., is said to be very promising as the result of recent discoveries in some of the producing mines. Consequently several claims which had been dormant for a number of years, as well as some entirely unexplored ground, are being taken up and explored.

Last month Vinegar Hill Zinc shipped 40 cars of sulphuric acid, valued at about $64,000, from its acid works near Benton. This company has just recently acquired the Monmouth, Booty, Copeland, New Longhorn, and Dawson properties, on which diamond-drill operations are being pushed. At present, the producing mines of the company are the Birkett, Mullen, and James mines, which produce both lead and zinc sulphides.

The mill of New Ida Blende is handling about 200 tons of mine-run ore a day, from which weekly shipments of about 150 tons of zinc concentrate, containing 45 per cent zinc, are made. Only one shift of 25 men is now working at the mill, which has a capacity double its present tonnage. To the east of the orebody being mined at present, the ore runs into virgin ground, which is considered very promising. No exploration work is being carried on in this tract, although it is owned by the New Ida company. William Eiler is the mining engineer in charge of operations.

Recently a strike of high-grade "resinjack" was made on the Paris Hill property, financed and operated by Chicago and local interests. The management has had some trouble with water, as the mine was flooded twice last week, when operations struck "breaks." The holdings of the company consist of 180 acres of ground, half a mile south of Benton, Wis., and are situated on the Chicago & Northwestern railroad. An electric power line runs through the center of the property, assuring an ample supply for necessary operations.

Receivership Asked for Monte Cristo Mining

MINORITY stockholders of the Monte Cristo Mining Company have asked for a receivership, based on the impending maturity of the first of three notes of $158,489.33 each, given last November by the manager of the corporation, of which C. C. Julian is president and principal stockholder, to the New Monte Cristo Mining Company, in which Mr. Julian is also president and principal stockholder. The application has had one day in the local courts in Phoenix, Ariz., before Judge Windes, who declared it outside of his province to serve as an expert. He therefore issued an order commanding submission of all records to H. T. Cuthbert, certified accountant, whose report was brought into open court. The audit covers the period from October, 1926, to June, 1927, on the basis of books submitted by the Julian interests.

The corporation's principal asset is accepted as the Monte Cristo group of 38 claims, near Wickenburg, Ariz. These are listed at the value of the issued stock, $1,200,000. Statement is made that the former owner, Ezra Thayer, of Phoenix, expended $590,597 in development work, and that $165,823 was thereafter spent on mine administration and $87,187, on equipment. An appended report of W. Gohring, mining engineer of Phoenix, shows the equipment in excellent condition, and ready for operation. The leading items of interest in the accountant's report were that from September, 1926, to June, 1927, $142,548 of the sum expended may be charged to Monte Cristo "overhead." There is distribution of 56 per cent to the Monte Cristo; 35 per cent to a Canadian property; and 9 per cent to the Silver Screen, a border mine held under option, and later surrendered to the owners. Thus gross total expenditures of $213,360 for field, traveling, administration, and interest charges are shown. Next to office expense came legal expenses, aggregating $41,606 for the period. Office and travel expenses and other charges amounted to more than $100,000. Receipts of the corporation for the period covered are set forth at $14,531.01, derived from the sale of ore and bullion. Of this amount $9,110.05 came from the sale of a silver bar exhibited in the company's offices in Los Angeles. This bar, exclusive of mining operations, would appear to have cost the company $2,195.15 for separation and casting charges. The balance of the money used in the administration of the company's affairs was advanced by C. C. Julian, or his New Monte Cristo Mining Company, and is covered by three notes. Harry B. Crouthers, manager, received $1,000 a month, and F. B. Hyder, superintendent, $600. Advertising cost $3,846, which included the cost of striking 1,400 Monte Cristo coins and 100 medals at a cost of $325.

United Verde Ex. Wins Suit Against Government

JUDGMENT for $879,533 has been awarded United Verde Extension Mining against the U. S. Department of Internal Revenue. This sum represents excess taxes paid by the company during 1918 and 1919 on buildings, machinery, and equipment at its mine in the Jerome district of Arizona. This additional property, it was claimed, was acquired after April 6, 1917, for manufacture of materials used in the prosecution of the World War.

Mining in San Juan Area Continues Active

Governor Adams Refuses to Appoint No. 4 District Inspector—Tram Installed at Old Hundred

MINING companies in the San Juan district in southwestern Colorado continue to show the activity noted in *Engineering and Mining Journal* of June 30. No definite plans have yet been made public concerning the erection of a zinc smelter near Durango to treat the complex ores of the district, but local miners feel certain that once the gas line to Durango is completed, the erection of a smelting plant will follow.

Governor Adams of Colorado stands firm in refusing to appoint a mine inspector for the Durango district, known as No. 4, despite the order of the district court that one be appointed. The case has been appealed to the state supreme court and Attorney-General Boatright has advised that the judgment of the governor be considered. T. R. Henahen, who is inspector for district No. 1, has been been acting as inspector for the Durango district.

A 5,300-ft. tram is being erected by C. M. Lane and C. K. Dresser, extending from the main working tunnel of the Old Hundred mine to the mill, which is being equipped with flotation equipment to treat 100 tons daily. Messrs. Lane and Dresser control 49 claims near Silverton, including the Old Hundred, Garry Owen, and Veta Madre groups. These mines all carry gold-silver-lead ore.

M. B. Burke, owner of the Ute and Ulay mines, near Lake City, Hinsdale County, Colo., will erect a 150-ton plant to treat the ore by flotation and concentration. Ore in sight at the mine is estimated at 225,000 tons.

Silver Queen Mining, which also owns groups of mines in Summit and Gilpin counties, has acquired a major interest in the Queen of the Hill and Queen of the West mines, on Hotchkiss Mountain, near Lake City. The company will operate these properties together with its other holdings in the district.

Production and Exploration Active at Pachuca Mines

AT Pachuca, Mexico, the Capula Mines, belonging to the late Frank Rule estate, are under option to the Real del Monte Company, which recently finished an extensive diamond-drilling campaign, the results of which have not yet been made public. The geology of this camp is identical with that of Pachuca. Vein structures are of good size and carry mineralization which may become important when a railway is built to tap the camp. Real del Monte is itself producing between 50 and 60 tons of bar silver per month.

The Santa Gertrudis mine, which a year or so ago was experiencing some difficulties, is now reported doing well on a new find.

Flotation plant being built by the Venus Mining Company, which owns the old Deer Trail ground

Thirty Years After Its First Boom Deer Trail District Is Again Active

Flotation Plant Being Constructed by Venus Silver to Treat Silver-Lead Ore—Snowdrift Mining Is Shipping Copper Concentrates to Tacoma—Other Properties Active

RENEWAL of interest in the Deer Trail district, in southwestern Stevens County, Wash., is evident this summer. About twelve properties are being developed at present in this district, which was mined intensively about 30 years ago. Comparatively high-grade silver ores occur in the region, the development of which has been hampered by lack of adequate transportation, but good highways to the railroads are now available.

The most important operation in the district is that of the Venus Silver Mines, which is installing a 100-ton flotation plant and which has taken over all the property of the old Deer Trail company. About 25 men are employed, and this number will probably be increased to 50 when the mill goes into operation about Sept. 1. Last fall, a body of ore, 4 ft. wide, was opened on the 800 level. It is expected to average about $25 a ton. Another orebody was found in the north end of the 600 level, said to be of similar width. It is estimated by Thomas Bentley, superintendent of the company, that there is enough ore on the dumps and in the mine to keep the mill operating for ten years. M. N. Shaw will be mill superintendent.

About two miles south of the Venus property, the Orazada Mining Company is developing a silver-lead mine. Although a 150-ton mill is planned, some of the ore is sufficiently high-grade to warrant shipping without treatment. The Orazada company was organized last year by Conrad Wolfle, of Spokane, and New York associates. Since then about 2,000 ft. of development work has been done by the ten men now employed.

The Aichan Bee Silver-Lead Mining Company is rebuilding the road leading to its property and retimbering the tunnel, preparatory to resuming operations, after a shutdown since 1926. A 35-hp. steam plant now on the property will be replaced with new equipment. The tunnel is about 700 ft. long and has exposed a vein carrying silver, lead, and zinc ores. This property adjoins the old Queen mine, which was the subject of litigation for many years.

L. E. Van Horn, who has been in the Deer Trail district for many years, is developing the Standard group of claims, a quarter of a mile northeast of the Queen. A crosscut, driven 400 ft., has struck what is said to be an extension of the Deer Trail vein, on which Venus Silver is working.

Snowdrift Mining, one of the few copper properties in the district, has started shipping concentrates to the Tacoma smelter. The company is operating a small mill, which has a present capacity of 25 tons a day, and which will probably be enlarged if developments warrant. An 80-hp. steam engine and a Diesel engine furnish the power for mining and milling operations. In addition to copper, the ore carries small quantities of gold. About fifteen men are employed under the direction of George Snow, president and manager.

L. E. Van Horn, the one man who was in the Deer Trail camp when the Deer Trail mine was located in 1894 and who still is mining in that region

Matchless Mine, Last of Tabor Properties, Is Sold

ON JULY 16, the Matchless mine, last of the many properties that formed the estate of H. A. W. Tabor, was sold at auction at Leadville, Colo., for $14,000. The property was acquired by the Shorego Mining Company. It carries silver ores.

H. A. W. Tabor was at one time United States Senator for Colorado and controlled a large number of properties throughout the state. He was responsible in part for the introduction of the cyanide process into the United States, in 1892, by forming and backing a company known as the American MacArthur-Forrest Company, of which Philip Argall was metallurgist. His widow, who had been involved in litigation for the ownership of the Matchless mine, left Leadville before the sale.

Consolidated M. & S. Resumes Development of Two Mines

Consolidated Mining & Smelting of Canada has resumed development of the George group, in the Bear River district of British Columbia, which was shut down during the winter, and of the Emerald group, in the Sibola district of the same province. A tunnel, driven by the late James Cronin at the Emerald several years ago, opened a promising deposit of high-grade silver-lead ore, but the inaccessibility of the district has prevented development.

Australian Commission Attributes Low Gold Output to High Mining Costs

MELBOURNE, JUNE 21, 1928.—The report of the Development and Migration Commission, of which H. W. Gepp is chairman, on the decline of the country's gold industry has been presented to the parliament of the Commonwealth of Australia. The commission affirms, what is already known, that the diminished gold output—from £14,600,000 in 1906 to £2,200,000 in 1926—results mainly from high costs of production. The price of gold has remained at prewar levels, whereas prices for all other commodities and wages have risen considerably.

It is stated that the gold deposits of Australia are not exhausted or even fully explored, but the economic position makes it unprofitable to mine the low-grade ores. The commission believes that the only hope for the industry is the mining and treatment of larger tonnages of low-grade ores. To this end, it is recommended that a fund of £250,000 be established by the commonwealth government for the purpose of assisting the industry by relief from the effects of the customs duties on machinery for new construction. Financial assistance is to be given only to permit gold mines to be equipped or re-equipped with machinery at a lower capital cost.

A cash payment, it is recommended, should be made for new machinery erected on gold mines. This grant would be payable, subject to the recommendation of the tariff board, whether the machinery were imported or manufactured locally. It would be equivalent to the amount of the duty that would be payable if the machinery were imported. This, it is considered, will conserve the interests of the Australian manufacturer, and, at the same time, assist the gold-mining industry.

Investigation has shown, the report states, that the Federal Precious Metals Prospecting Act of 1926 has not helped materially. State grants, on the whole, have been sufficient to fill the demand. The recommendation to apply the unexpended part of the federal grant (about £36,000) to the provision of expert technical assistance is designed to help state departments to apply the best available knowledge to difficult problems. In view of the decadent status of the industry it is unlikely that each state can afford, on its own account, experts of the required standing.

Relief from taxation, uniform mining laws, encouragement of prospecting, metallurgical research, and greater cooperation between employers and employed are other desirable features to which the report directs attention as possible aids.

International Smelting Warehouse Burns at Miami

THE STEEL-FRAME and galvanized-iron warehouse of the International Smelting Company, at Miami, Ariz., was destroyed early on the morning of July 7 by a fire which reduced it to a jumble of bent sheets and twisted beams. The loss is estimated at between $75,000 and $135,000. Although the iron walls of the warehouse were red hot while the fire was at its height, and the heat was intense, the company's gasoline and oil house, standing on the same foundation as the warehouse and separated from it by only 8 ft., was saved. The warehouse and contents were fully covered by insurance. Before noon that same day a temporary structure had been started to serve as an emergency warehouse. Ten minutes before the fire started a company watchman had walked the length of the building and punched his time on a recording clock. He afterwards reported that he saw nothing wrong or suspicious.

L. O. Howard, superintendent, took personal charge of the fire-fighting crew, which consisted largely of smeltermen called from work near by and volunteers. The non-combustible nature of the building made the flames within more difficult to control. Mr. Howard had his wet shirt blistered fast to his body, but his injuries were temporary.

Cable Tramway Installed at Thunder Creek Mine

ACCORDING to Henry S. Volkmar, president of Thunder Creek Silver-Lead Mines, a working crew is now at the company's property in the Cascade Mountains, Skagit County, Wash., erecting surface buildings and installing a cable tramway up the mountain side. Mining operations will be started soon by the Cascade Mineral Corporation, which has been formed to operate the property on a lease. Lack of transportation facilities to date has prevented adequate development of the mine, which was originally discovered in 1902.

In addition to silver and lead, the ore carries gold, copper and molybdenum. Ore is reported in sufficient amount to justify immediate erection of a mill.

Originally the distance from the property to the nearest railroad was 52 miles. This has been reduced to 18 miles, and the remaining distance will be covered either by a truck road or a narrow-gage railroad.

Carlisle Mine Closes

The Carlisle mine, situated about 13 miles north of Duncan, N. M., has been closed and the crews have been dismissed. P. F. Boswell, who has been managing the property for the last year, has resigned. Reasons for the shutdown have not been made public.

The history of the Carlisle mine dates back to 1881, when it was operated by an English company. It is said to have had a total output of $4,000,000 in gold and silver, although it has not produced for the last 30 years.

Silver Recoveries Improve at A.M.Co. Presidio Property

AN examination of properties in the vicinity of the only operating silver mine in the Shafter (Texas) region has recently been completed by P. K. Lucke, mining engineer, of San Antonio. The Presidio Mining Company property, the mine to which reference is above made, is owned by the American Metal Company. It is the only silver mine of notable importance in the state. The ore occurs mostly in chimney form, in Upper Cretaceous limestone, which until recent time was covered by andesite and volcanic flows.

At the Presidio property the galena is concentrated out and the silver ore is sent to the cyanide plant. Production of silver-lead ore amounts to about 5,000 tons per month. Extraction has recently been markedly improved.

Plead Not Guilty in Canario Copper Stock Case

All five of the individuals indicted with Cameron, Michel & Company in the investigation of the affairs of the Canario Copper Company pleaded not guilty when they were arraigned before Federal Justice Charles C. Cavanah in New York City recently. The indictment, which was made last April, was based on alleged misrepresentations on the part of the five persons and the stock brokerage concern in connection with the sale of more than $500,000 worth of stock of the Canario company. The individuals, three of whom, George Shurtleff and the Locke brothers, were members of the Cameron firm, and the other two employees of that firm, were released on bail.

Mond Nickel Shaft Now Is Deepest in Sudbury District

The new shaft of Mond Nickel at its Frood Extension property is now down to 3,300 ft., making it the deepest shaft in the Sudbury district. It is a three-compartment shaft, measuring 7 ft. x 19 ft. 4 in. No stations were cut while sinking was being done, but this work will now proceed on the 2,800, 3,100, and 3,300 levels. A development winze, which is being sunk from the 200 level, is down about 25 ft. and the long drift being driven on the 2,000 level is in for a distance of more than 3,200 ft. As the ore is dipping into Mond ground at an angle of 63 deg., it is estimated that the length of ore on the bottom level should be nearly double that at the 2,000 level. The width of the orebody is said to vary from 60 to 130 ft.

Mexico City Letter

By W. L. Vail
Special Correspondent

Santa Fe Acquires Railroad in Northern Mexico—Lines Now Building Will Aid Mining

Mexico City, July 9, 1928.—The sale of the Kansas City, Mexico, & Orient Railroad to the Atchison, Topeka, & Santa Fe line, contingent on the approval of the U. S. Interstate Commerce Commission, means the ultimate development of a big stretch of valuable mining territory in the states of Chihuahua and Sinaloa. The K. C., M. & O., which runs from Kansas City to Alpine, Tex., still has 40 miles to build before it will connect with the Chihuahua division, now almost completed at Ojinaga. A branch line of 60 miles will also be completed from San Angelo, Tex., to Del Rio, where it crosses the Rio Grande at Las Vacas and connects with the Mexican National, which runs to Mexico City. When the Chihuahua and Alpine divisions are completed, a short line will be opened from Topolobampo, Chihauhua, to Kansas City, affording comparatively cheap transportation for the mines in western Chihuahua and eastern Sinaloa.

San Nicolas Mining, controlled by the Latin-American Milling Company, of Los Angeles, is making preparations for the treatment of 300,000 tons of tailings near Vicente Guerrero, Durango. The company also owns three mines in the vicinity, on all of which development work is being done. It has a 400-hp. 4 cylinder Diesel engine working, and another one of equal capacity will be installed. The company is distributing its power over a high-tension line three and a half miles long. Water is supplied by a 6-in. water line of the same length. The mill on the property has a daily capacity of 200 tons, which will be increased to 300 tons by Sept. 1. Harley A. Sill and H. J. Moffett are now at the camp.

The El Boleo copper mine, in Southern California, is considering increasing its output, now about 1,000 tons a month. Ore from the mine, as delivered to the smelter, is averaging about 4 to 5 per cent copper.

There is some talk of starting work on the recent discovery of what is said to be the lost portion of the Mother Lode between the El Cedro and the Guanajuato Consolidated properties, in the Guanajuato district, State of Guanajuato. Nothing, however, is definite. The strike that is supposed to indicate the extension of the Mother Lode was made on the properties of the Peñoles company at a depth of 1,180 ft. Most of the mines in the district are operating at normal capacity. Guanajuato Reduction, of which Augustus McDonald is now general manager, is treating 400 tons of silver ore daily.

Sink Shaft at Old California Property

Belmont Metal Corporation is sinking a shaft at the Colorado mine, 7 miles north of Mariposa, Calif., near the head of Saxon Creek. The property is an old one, which has not been operated since 1917. It is equipped with a Cornish pump, 10-stamp mill, and gas engines.

London Letter

By W. A. Doman
Special Correspondent

Penpoll Tin-Smelting Works at Liverpool Will Be Largest in World

London, July 3, 1928.—As for many weeks, tin is the outstanding topic in mining circles. The unreliability of the statistics and the lack of confidence in the published figures may be seen from the fact that, though one prominent person in the mining world asserts that there is overproduction, another has boldly stated that industry is undersupplied and that there are no hidden stocks. Whichever is correct, price seems to make no difference.

There is talk of America being in the market again, but Germany, from which much was expected, remains a mystery. Tin-plate trade in South Wales is reported to be improving, and, generally speaking, everyone concerned is becoming more hopeful. What apparently is to be one of the deciding factors in regard to price of tin in the future is the Penpoll Smelting Works, near Liverpool, which will be opened on July 13 by Lord Derby. It is to be the most up-to-date tin smelter in the world, and the largest.

Despite the fall in price of the metal, some of the Malayan tin companies are still able to earn substantial profits, this being made possible by a reduction of costs and by increasing outputs. That tin mining under sound management can be made profitable—dredging properties, at least—is clear from the fact that several companies are earning profits ranging from £70 to £90 a ton. The result is that investors are again turning their attention in this direction.

Just at the present moment there is a hesitating tendency in consequence of the high rate on money in New York. Fears are entertained of a collapse in that center, the effect of which would be to bring down international stocks and such speculative holdings as mining shares. Some leading people are advising clients to sell everything and keep their money liquid to pick up bargains at a later date.

Melbourne Letter

By Peter G. Tait
Special Correspondent

New Horseshoe Company Is Formed After Mine at Kalgoorlie Closes

Melbourne, June 11, 1928.—The Golden Horseshoe mine, at Kalgoorlie, which had resumed operations after a period of quiescence early last year, closed down again recently. The announcement of closing was immediately followed by another, however, advising of the formation of a new company with a working capital of £100,000. Golden Horseshoe was once the richest mine on the Kalgoorlie field, and between 1899 and 1924 its stockholders received £3,652,000 in dividends. By the middle of 1926, gold to the value of £12,549,931 had been produced, but about that time the mine closed down because of high operating costs. At that time, the estimate of ore reserves was still several hundred thousand tons, with a few high-grade sections of ore known to exist in the mine.

The new Horseshoe company will have to assume liabilities to the Western Australian government amounting to £55,000. C. E. Blackett, metallurgist of the company, has recently been experimenting with the bromo-cyanide process, used in Kalgoorlie many years ago, and results have been encouraging. One advantage of the process is that the roasting of the ore is eliminated, thus reducing treatment cost and providing hope for future profitable operations at this famous old property.

Broken Hill Block 14 is forming a separate company, Block 14 Exploration, for the purpose of prospecting and developing new properties. The new company will have a capital of £35,000 in 70,000 shares, of which 4,000 shares will be retained by the parent company, which is underwriting 40,000 contributing shares. Several promising silver-lead areas have been selected in Tasmania and are now being investigated.

South Comet Zinc-Lead Mine, Ltd., at Dundas, Zeehan district, Tasmania, which was formed when lead was quoted at a high price, has been closed after more than £50,000 had been spent in an endeavor to make it a profitable producer. The moving spirit in the venture was T. H. Palmer, formerly of Broken Hill, who optioned the property while acting as agent for Beer, Sondheimer & Company, ore buyers. Although he devoted much of his energy to the development and equipment of the mine, the drop in the price of lead proved too great a handicap. Mr. Palmer evidently took the failure very much to heart, as he was found drowned on the sea coast near Melbourne a few days ago.

Mexican Antimony Output Decreases

Large Deposits of Metal, However, Indicate Splendid Possibilities for Future

MEXICO, in recent years accorded second place in world production of antimony, mined much less of that metal last year, according to reports from American consuls at Mexico City, San Luis Potosi, and Nogales, made public by the U. S. Department of Commerce. Official figures placed Mexico's antimony output in 1927 at 1,894 tons, compared with 2,573 tons in 1926, which was a record year.

The entire State of Sonora, from the Sierra Madre Mountains to the Gulf of California, has been referred to as an "antimony province," and there is hardly a section that does not have its antimony prospect. The most important and productive field in the state is that of the Altar district, whose mines are situated about 30 miles west of Caborca and an equal distance east of Port Lobos, on the Gulf of California. It is about 117 miles from the mines to the railroad, and Santa Ana is 70 miles, by railroad, south of the international boundary line.

Antimony deposits in the Altar region occupy about 35 square miles, but the main deposits are centered within an area approximately three miles long and two miles wide. They are among low hills and rolling country, at a slight elevation above sea level. Here are found large deposits of relatively pure oxide of antimony. Silver-bearing antimony ore is also reported to have been found in this section.

The Altar fields furnished 1,391,520 lb. of the Mexican production of antimony in 1927—approximately 29 per cent less than their contribution in the preceding year. It should be remembered, however, that 1926 was a record year in the industry. The trend of production may be seen by the exports of fine antimony to the United States in recent years; they totaled 36.100 lb. in 1915, increasing to 1,510,730 lb. in 1918. There was a decided decline in the following year, and no production appeared from 1920 to 1924, inclusive. Production resumed in 1925 with an exportation of 341,043 lb., and 1,804,979 lb. was exported to the United States in 1926.

Metals Mining & Smelting Mill Put Into Operation

THE new ten-stamp mill of Metals Mining & Smelting Corporation at Montague, Halifax County, Nova Scotia, was recently put into operation by G. S. Harrington, Minister of Mines for the province. The mill is of the latest design, containing crushers, stamps, and Wilfley tables, and has a capacity of 50 tons a day. It is stated to be the first unit of a larger mill which is contemplated.

Personal Notes

C. O. LINDBERG, of Los Angeles, is now in New York.

ARTHUR NOTMAN has returned to New York from a professional engagement.

W. LEE HEIDENREICH is now in Alaska examining several mining properties.

FREDERICK E. SCHMITT has been appointed editor of *Engineering News-Record*. Mr. Schmitt has been on the staff of the publication since 1902. He

FREDERICK E. SCHMITT

is perhaps best known for his report on the collapse of the Quebec bridge in 1907, which won countrywide recognition by its accurate and detailed analysis of the causes of the failure. Mr. Schmitt succeeds Frank C. Wight, who died last September.

J. F. COOK, consulting mining and mechanical engineer, left Johannesburg recently for London.

F. C. BAKER, of the New York office of Consolidated Goldfields of South Africa, is in London.

Dr. W. S. MCCANN has returned to London after spending four months in Southern and Northern Rhodesia.

FRANK M. SMITH, smelter director of Bunker Hill & Sullivan Mining & Concentrating, visited the Salt Lake district last week.

PAUL BILLINGSLEY, consulting mining geologist, of Salt Lake City, is making an extended business trip through the Northwest.

O. F. OHLSON has been appointed general manager of the Alaska government railroad. Mr. Ohlson succeeds NOEL W. SMITH, resigned.

DE WITT SMITH, managing director of United Verde Copper, returned to New York recently from a visit to the company's properties at Jerome.

A. B. HARDWICK, statistician of International Smelting, returned to his headquarters in Salt Lake City on July 5 from a ten days' business trip to California.

HERBERT C. ENOS has returned to Los Angeles from Nevada City and Death Valley, Calif., where he has been making examinations of mines and sulphur properties.

DR. WALTER E. ROLOFF, head of the department of economics at the University of New Mexico, has accepted a position with the Colorado School of Mines at Golden, Colo.

E. BALIOL SCOTT, editor of *The Mining Journal*, won a "very handsome silver mug, 230 years old" at the summer meeting of the Mining and Metallurgical Golfing Society.

P. E. ATHAS, president of Magna Gold Mines, has returned to Salt Lake City from a visit of several weeks to the property of the company situated 45 miles southwest of Austin, Nev.

GEORGE A. PACKARD, mining engineer, of Boston, will be in Neihart, Mont., in July and early August. He intends to visit the Globe district of Arizona before returning to Boston in September.

COMPTON I. WHITE, manager of the Whitedelf property, in the Clark Fork district of Idaho, returned to Clark Fork recently, after attending the Democratic National Convention at Houston, Tex.

Dr. R. C. WALLACE, head of the department of mineralogy and geology at the University of Manitoba, and Commissioner of Mines for the province, has been appointed president of the University of Alberta.

H. T. TYRELL is in charge of development work on a group of 23 claims adjoining the property of Gem Lake Mines, in northern Ontario. The work is being carried out by New York and Toronto interests.

D. F. HEWETT, of the Geological branch of the U. S. Geological Survey, has left Washington to visit mining districts in the West in connection with his studies of dolomitization and its relation to ore deposits.

THEODORE R. WRIGHT, superintendent of concentrators of Cerro de Pasco Corporation, is on leave from Cerro de Pasco, Peru, and is visiting Western mining districts, where he is investigating recent milling practice.

F. O. WILLIAMSON, of the Williamson Company, of San Francisco, in-

ventor of the Williamson ball mill, was recently in the copper districts of Arizona, where he made a special study of the installations of his mill.

OTTO SUSSMAN, vice-president of American Metal, will sail for Europe late in July. During his absence, HARRY L. BROWN, who returned recently from Cuba, will be stationed at the New York offices of the company.

BLAKE R. VANLEER, assistant professor of mechanical engineering at the University of California since 1920, has been appointed assistant secretary of the American Engineering Council, succeeding A. G. OLIPHANT, who has resigned.

C. N. GERRY, statistician at the Intermountain Station of the U. S. Bureau of Mines, returned to his headquarters there on July 5 from a week's visit to various mining properties in the Star and Iron Springs districts of southern Utah.

A. M. GAUDIN, associate professor of metallurgical research of the University of Utah, and C. T. VAN WINKLE, consulting mining engineer, of Salt Lake City, returned to that city on July 7 from a two weeks' inspection trip to the Philipsburg, Mont., mining district.

H. I. SMITH, associate chief of the conservation branch of the U. S. Geological Survey, and B. W. DYER, district engineer, with headquarters at Salt Lake City, are making an inspection trip of government-owned mineral properties in Oregon, Idaho, and California.

D. M. DRAPER and O. W. EWING, of Salt Lake City, Utah, presented Senator Joseph T. Robinson, of Arkansas, Democratic candidate for vice-president, with a gavel the head of which consisted of copper from the Bingham mine of Utah Copper, at the recent Democratic National Convention.

Dr. HARRISON SCHMITT, chief geologist for the southwest division of the New Jersey Zinc Company, left for Parral, Chihuahua, on July 15 from Hanover, N. M. Dr. Schmitt will complete an examination of the properties of American Smelting & Refining in the Cordero district which he was forced to abandon in 1926 because of trouble with bandits.

GRANT B. SHIPLEY, of Pittsburgh, Pa., has recently been elected a director of the Mond Nickel Company, Ltd., of England and Canada. For some time Mr. Shipley has been chairman of the board and president of the American Mond Nickel Company, Ltd., which has offices at Pittsburgh and a plant at Clearfield, Pa., where the company manufactures pure nickel and nickel alloy products.

WALTER L. REDROW has been appointed by President Coolidge to the position of examiner-in-chief and member of the Patent Office Board of Appeals. He succeeds the late Sidney F. Smith. While serving as an examiner in the Patent Office, Mr. Redrow has had experience in those classes of invention involving metallurgy, electrochemistry, and other related technical and chemical subjects.

ERNEST W. ELLIS, assistant professor of mining and metallurgy at the University of Idaho, has been appointed acting secretary of the Idaho Bureau of Mines and Geology by Governor H. C. Baldridge. He will serve in this post until the state board of education appoints a new dean of the school of mines at the university to succeed Dr. F. A. THOMSON, who recently resigned.

Dr. EDWARD DEAN ADAMS, engineer of New York City, has received an honorary doctorate from the University of Louvain, and has been made Commander of the Order of the Crown by the Belgian government. Dr. Adams represented the Engineering Foundation at the dedication of the Louvain Library and the engineers' memorial carillon and clock on July 4.

G. H. BLANCHETTE, exploratory engineer of the Canadian Department of the Interior, is in charge of the expedition which sailed from Halifax, N. S., recently in search of minerals in the territory surrounding Hudson Bay. He has secured leave of absence for two years. J. C. ROGERS, consulting engineer of Toronto, is in charge of the geological department of the expedition.

JAMES G. HALL and ENOS CURTIN, New York brokers who set off for the Chibougaman district in Quebec by airplane on July 7, were found safe on Lake David, Quebec, on July 16. They had been forced to alight there on Sunday, while on their way to look over some gold claims with a view to financing them immediately. Lake David is only about 20 miles from the Chibougaman district. Sixteen planes were chartered by telegraph to look for them.

J. J. WARREN, president; S. G. BLAYLOCK, general manager; and W. M. ARCHIBALD, chief engineer of Consolidated Mining & Smelting of Canada, recently inspected the development work that has been done at the Big Missouri group in the Salmon River district of British Columbia. Three diamond drills have been running day and night for some time, presumably to determine whether final payment on the property, which has been optioned by Consolidated, will be made this month when it becomes due.

H. C. Smith—An Appreciation

A friend and professional associate of H. C. Smith, American mining engineer at Pachuca, State of Hidalgo, Mexico, who was murdered on May 30, as reported in "Engineering and Mining Journal" of June 9, has sent us the following appreciation:

BY THE tragic death of H. C. Smith, the mining profession loses an engineer of outstanding ability and a man who has inspired, to a rare extent, the admiration and devotion of his friends. To all of us who knew the Dos Carlos mine in its development stages, the achievement of bringing it up to a production of 25,000 tons per month, within eighteen months of crosscutting the vein from the old Santa Gertrudis mine, will always remain an astonishing feat; no small share of the credit belongs to Smith. But mines, especially mines in Mexico, cannot be operated successfully by technical ability alone. Force of character, a sensitive understanding of human beings, and an ability to translate this understanding into a sure touch in handling men—all the qualities of leadership—are the indispensable adjuncts of technical skill. It was his ability to inspire others with his own enthusiasm, his own will to overcome the most formidable difficulties, and, perhaps more than all else, his ready and sympathetic understanding of his subordinates' problems that made "Si" so beloved by all who have been privileged to work with him. He never spared himself, yet his endeavor was always to spare others, and many times he was heard to say to a foreman, after a hard morning's round, "Well, don't go and do too much climbing this afternoon; take it easy round the levels."

No man was ever more loyal to his assistants. When things went well, "The Boss" saw to it that his foremen got the credit with the management, but always when things were awry he would step in and take the kicks, which were the deserts of others, himself.

"Si" was the most sympathetic teacher that ever helped a young engineer: he was never dogmatic, and no subordinate ever put forward an idea that was not given a fair trial and a helping hand. Small wonder, then, that he commanded a loyalty and affection such as fall to the lot of few executives.

The soul of generous hospitality, his house was always open. The Smiths' New Year's Day party was, for many years, an annual tradition in Pachuca, and innumerable evenings of supper and bridge will remain to many as the most delightful of our Mexican experiences, for he had, to a marked degree, the Westerner's genius for being the perfect host.

To his friends, his loss is irreparable and leaves a gap that no one else can ever quite fill; yet we can take comfort from the fact that "Si's" short life was one of achievement; he has left behind with us who worked with him an ideal of "straight-shooting," and we know that he looked on death with the same calm heart and steady eyes with which he had always faced life.

OBITUARY

BYRON BURR STOWE, manager of W. A. Harriman & Company's manganese concession in the Russian Caucasus, died recently from sleeping sickness.

BOOK REVIEWS

The Restless Prospector

OPALS AND GOLD. By R. M. Macdonald. Pages 256; illustrated. Philadelphia: J. B. Lippincott Company. Price $4.

THIS is the account of the experiences of a prospector in Australasia, written in an easy and readable style. It covers wanderings, labor, and observations in the opal regions of Queensland and New South Wales, the pearl fisheries of the north, the desert regions of the west and the interior, and the tropic jungles of Papua. The objective changed with kaleidoscopic rapidity, and wealth within easy reach seemed to exert no lure when a new adventure beckoned in the distance. The author has made the account doubly interesting by adroit characterizations of his associates, designated as The Professor, Big Sam, Parson Joe, The Inventor Fellow, Fiddling Peter and many others, each of whom has been endowed by the author with traits and peculiarities that add to the interest of the narrative.

The book will prove a strong incentive to the restless that they go and do likewise. It exudes optimism—which every prospector needs. Wealth is there for the taking, according to Mr. Macdonald, who says little about the disappointments and the heat, the hordes of flies and the bad water in the mineral regions of the great continent, or of the inevitable sickness that haunts the swamps and jungles of Papua, which is described as the "Klondike of the future."

Unfortunately, dates are not given, and much of the inferred advice is misleading. The author stresses the great value of molybdenum, in quest of which "most prospectors have abandoned the search for gold, copper, tin, and gem stones . . ." This statement should not be taken too seriously; in fact, the color of the whole narrative is a little too rosy, but the sustained optimism acts as a tonic.

The book will be read widely and will be appreciated by all who are looking for diversion and desire acquaintance with the undeveloped mineral regions of a part of the world that, it is true, has not been prospected as thoroughly as it deserves. As was the case with the Panama Canal, much missionary work in improving living and hygienic conditions is necessary before extensive penetration is possible into all the regions visited by Mr. Macdonald. His book, however, is an inspiration and in some respects an education. He writes well and interestingly, and more should be heard of him.

Many readers will doubtless hope that, in his next volume Mr. Macdonald will add an explanation of the mystic initials "F.R.S.G.S." that follow his name on the title-page.

A. W. A.

TIN MINING. By C. G. Moor. Sir Isaac Pitman & Sons, Ltd., New York. Cloth, 5½ x 8½ in., illustrated, 171 pages. Price $2.50.

COMING as it does when tin is receiving the close attention of economists because of price and market behavior, the appearance of this volume is timely. The technology of tin mining has not received so much attention as has been devoted to the more common non-ferrous metals, but Mr. Moor's work takes a step toward correcting this condition.

Starting with a detailed description of cassiterite, the one important ore mineral of tin, its mineralogical associations and the geology of tin ore deposits, the author proceeds to discuss prospecting for tin; sampling of mines, dumps, tailings, and beach sands; assaying of tin products; lode mining; milling and dressing; alluvial tin, occurrence and dredging; power for mining purposes; economics; business management of tin mining properties; and the history of the metal. The book is written in a style easy to read, and will perhaps prove of more value to the mining man than to the technician. It is a worthwhile contribution to a subject that has received less discussion than it deserved in technical publications, in the past.

H. L. J.

MINE LIGHTING. By J. W. Whitaker. Methuen & Company, 36 Essex St., London, W.C.2, England. Pages 200. Price 8s. 6d.

THE subject of this volume of mine lighting should be interesting to coal- and metal-mine operators alike. Aside from his exposition of the scientific principles of illumination, the author has British practice in mind, and coal-mining practice at that. The American metal-mine operator will therefore find parts of the book that have but little interest for him. Without doubt, lighting conditions in the average metal mine today could be greatly improved. Long habit and tradition cause faulty illumination to be taken as a matter of course. Carbide lamps for the miner, a limited use of electric light in stations and main haulageways, and the occasional flood-lighting of stopes—these three things summarize the advance in metal-mine lighting in the United States. A deeper study of the subject would be worth while.

A. H. H.

KEYSTONE METAL QUARRY CATALOG. 1928. McGraw-Hill Catalog and Directory Company, 475 Tenth Ave., New York. Price $15. Pages 478.

THIS is the eighth annual issue of what has proved a most useful volume to mine and quarry superintendents and purchasing agents. In it the catalog pages of the various manufacturers have been brought together so as to make complete catalog units controlled by one index. Reference has been greatly facilitated by the new arrangement. The editorial data have similarly been assembled as one unit with one index, instead of being scattered over 24 different sections as before. The book is the most useful catalog of mining and quarrying machinery, materials, equipment, and supplies yet produced.

SINGLE-ROPE TRAMWAYS—The *Journal* of the South African Institution of Engineers for May publishes a seven-page article entitled "Monocable Aërial Ropeways," by E. C. Bowley. The writer limits his discussion to an application of the monocable system. He describes the system briefly and shows a layout of an installation on the property of the Lydenburg Platinum Areas, Ltd., Maandagshoek. After overcoming initial difficulties, the Lydenburg tramway has successfully supplied the necessary tonnage. In a period of three months 70,200 loads were transported with only two slips and three mis-hooks. Moreover, in cold months, 99.3 per cent of the specified running hours was obtained.

ECONOMIC GEOLOGY—In an editorial in the June-July number of *Economic Geology*, C. K. Leith discusses the subject "What is the Job of the Economic Geologist?" In conclusion he says, "In short, the primary allegiance of the economic geologist is to pure science. Of necessity he must learn something of the economic field. The additional opportunity now opens wide before him to aid in the interpretation of his field for the public welfare. Does the adjective 'economic' in our title limit our field too narrowly for the future? Will the time come when it should be replaced by something broader, or even dropped?"

PIGMENT MINERALS—Bulletin No. 3 of the Geological Survey of South Australia, published at Adelaide, is devoted to the subject of pigment minerals in that state. The author is R. Lockhart Jack, deputy government geologist. The three principal minerals of the class described that have been worked in the state are barytes, ocher and talc. In 1927 their production respectively was 20,348, 2,665 and 2,161 tons. In the bulletin, attention is confined to materials used in paint manufacture without chemical changes.

BIRCH CREEK, IDAHO—The geology and ore deposits of the Birch Creek district, Idaho, are described in a paper (Pamphlet No. 27), issued by the Bureau of Mines and Geology at Moscow, Idaho. The author is P. J. Shenon. Several suggestions for prospecting are given in conclusion. From 1881 to 1890 the mines of this district were among the most important producers of lead and silver in the state.

HYDRAULIC MINING—The first installment of a paper on this subject appears in the *Canadian Mining Journal* for June 29. J. Hume Robertson is the author.

MARKET AND FINANCIAL NEWS

July, 1928, Dividends Establish Record for Month

By Homar L. Johnson,
Assistant Editor

DIVIDENDS disbursed by American mining companies this month amount to $21,217,374, a new July record for all time. Distributions during the first month of the last seven quarters are shown in the following table:

	1927	1928
January	$18,960,995	$20,486,560
April	16,765,500	18,256,890
July	18,901,426	21,230,143
October	13,910,750	.....
Average	17,134,668	19,991,197

A feature of this month's increase is the dividend resumption by Greene Cananea Copper. The $1 per share payment announced for distribution July 2 marks the end of this organization's absence from the dividend-paying fold, an absence of some eight years' duration. Improved efficiency of operation at the company's properties in Sonora; the higher price for copper; and the favorable background of the large tonnage of high-grade ore in the lately proven Colorado orebody are responsible for the resumption of dividends. Another copper producer, Phelps Dodge Corporation, has shown the effect of the higher price of copper on earnings by increasing its quarterly dividend disbursement from $1.50 to $2 per share. Consolidated Lead & Zinc, operating in the Tri-State district, announced a 25c. per share payment on July 1, after fifteen months among the non-dividend payers. New Jersey Zinc pays one of its two annual extra dividends of $2 per share this month.

The bad news is less important than the good, as the increase in the total for the month indicates. Of the regular payments expected this month the apparent absentees are: Plutus Mining; Lucky Tiger-Combination; and the foreign-controlled Patiño Mines & Enterprises. Continued decline in the price of tin appears to have affected Patiño's earnings considerably. No word has been received from Lucky Tiger-Combination, and the passing of its monthly dividend comes as somewhat of a surprise. No explanation for Plutus' absence is readily forthcoming, as operations at this Utah property have recently been reported as progressing satisfactorily. Orebodies of the replacement type in the Tintic lime stones are capricious affairs, however, and are likely to pinch out, or open up, without notice. Premier Gold, important British Columbia gold and silver producer, has reduced its quarterly dividend rate from 8c. to 6c. per share. Great Northern Iron Ore, which pays dividends irregularly, reported a disbursement of 75c. per share in April that is missing this month. Erupçion made its last appearance on the dividend list in January. Ore reserves at the company's property in Chihuahua are nearing exhaustion, according to report, and stock-market operations on Erupçion shares have declined precipitously during recent months. Douglas Mining, a small Idaho producer of silver-lead ores, and Portland Gold, Cripple Creek producer, reported dividends a year ago this month, but have not been heard from since.

All in all, it may safely be said that the tendency of dividend disbursements continues toward higher and higher levels, a condition that must indicate, with some degree of precision, the prosperity of the metal-mining industry.

E. & M. J. Compilation of Mining Dividends and Yields for July, 1928

Companies in the United States	Situation	Per Share	Total	Per Cent Annual Yield
Aluminum Co. of America, pfd	Various	$1.50 Q	$2,214,930	5.5
Bethlehem Steel, pfd	Various	1.75 Q	1,697,500	5.9
Bingham Mines, s,l	Utah	1.00 Q	50,000	j8.7
Bunker Hill & Sullivan, l,s	Idaho	0.75 MX	234,250	6.4
Bunker Hill & Sullivan, pfd	Idaho	2.25 A	16,458	....
Cleveland-Cliffs Iron	Mich.	1.00 Q	400,000	3.7
Consolidated Lead & Zinc	Kan., Okla.	0.25 K	56,000	j1.9
Cresson Consolidated Gold	Colo.	0.10 Q	122,000	35.6
Eagle Picher Lead, pfd., l,z	Okla., Mo.	1.50 Q	12,769	....
Homestake Mining, g	S. D.	0.50 M	125,580	j9.7
Inland Steel, pfd	Minn.	1.75 Q	175,000	6.1
Kennecott Copper	Alaska	1.25 Q	5,623,022	5.4
Magma Copper, c,s	Ariz.	0.75 Q	306,116	5.7
New Jersey Zinc	Various	2.00 X	981,632	5.5
Newmont Mining, h	Various	1.00 Q	452,760	2.5
Nichols Copper, pfd	N. Y.	1.75 Q	40,247	....
Park Utah Consolidated, s,l,z	Utah	0.20 Q	418,700	6.7
Phelps Dodge, c	Various	2.00 Q	1,000,000	j5.6
Republic Iron & Steel, pfd	Various	1.75 Q	437,500	6.7
Silver King Coalition, s,l	Utah	0.25 Q	304,025	j9.2
Sloss-Sheffield Steel & Iron, pfd	Ala.	1.75 Q	117,250	6.1
U. S. Smelting, Refining & Mining, s,l	Various	0.875 Q	306,350	7.4
U. S. Smelting, Refining & Mining, pfd	Various	0.875 Q	425,557	6.5
Virginia Iron C & C., pfd	Various	2.50 SA	125,000	9.1
Companies in other countries:				
Asbestos Corporation, pfd	Quebec	1.75 Q	130,482	7.7
Consolidated M. & S., l,z,s	B. C.	6.25 S AB	3,180,394	4.7
Dome Mines, g	Ont.	0.25 Q	238,333	11.4
Greene Cananea Copper	Sonora	1.00 R	500,000	....
Hollinger Consolidated Gold	Ont.	0.10 4 wks.	492,000	9.4
Howe Sound, s,c,l	B. C., Mex.	1.00 Q	496,038	6.8
Nipissing, s	Ont.	0.075 Q	90,000	9.7
N. Y. & Honduras Rosario, g,s	Honduras	0.50 QX	100,000	13.3
Premier Gold, s,g	B. C.	0.06 Q	300,000	j13.0
San Francisco Mines of Mexico, l,s	Chihuahua	ls 3d	£92,997	....
Total			$21,230,143	

s, silver; l, lead; z, zinc; g, gold; c, copper; h, holding; R, resumption; Q, quarterly; M, monthly; X, extra; K, irregularly; QX, $0.25 regular and $0.25 extra; SA, semi-annually; SAB, semi-annual, $1.25, bonus $5; MX, monthly 25c., extra 50c.; j, based on dividends for the last twelve months.

STATISTICAL NOTES

Ore & Chemical Corporation, American agents for Metallgesellschaft, is authority for the following: "In regard to the recently announced decision of the Metallbank und Metallurgische Gesellschaft A.G. and Metallgesellschaft A.G., both of Frankfurt (Main), Germany, to merge under the name of Metallgesellschaft A.G., it is learned that both companies will call a meeting of their shareholders on Aug. 6, 1928. It is proposed to transfer the entire capital stock of the Metallgesellschaft to the Metallbank und Metallurgische Gesellschaft. The paragraph of the bylaws dealing with the purposes of the new company will formally be amended, although practically nothing will be changed, as the new company will continue to deal in ores and metals and transact all business in connection therewith, without relinquishing in any way its banking and financing privileges."

Consolidated Mining & Smelting Company's production of metal for the quarter ended June 30, 1928, was 40,176 tons of lead, 19,685 tons of zinc, 2,438 tons of copper, 81 tons of cadmium, 6,027 oz. of gold, and 1,734,185 oz. of silver. This is less than the output for the first quarter of 1928, but more than the output for the corresponding period of 1927; the curtailment was occasioned by new construction.

Undue Influence of Meager London Business on Zinc Prices

By International Metal Service, London

(Honorary Foreign Correspondent of the American Zinc Institute, Incorporated.)

WHATEVER may characterize the zinc markets in America, those in Europe can truly be described as lifeless. The daily quotation of the London Metal Exchange governs day-to-day business in slab zinc in the Old World, yet that price is dictated at times by ridiculously small bookings. It is true that the London market is free and open, and occasionally the volume of business is heavy. Not infrequently, however, the turnover is under 300 long tons a day, and it may happen that a smelter engaged in hedging against ore takings that day influences the price downward. Now, consider that actual consumption in zinc in Europe is higher than at any time since the war, and you have a typical instance of the tail wagging the dog. The newly established cartel does not aim at price control on the London market, so it does seem a shame that half a dozen of the leading producers do not get their heads together and by careful "jobbing" prevent the quotation from becoming unduly depressed on those occasions when extraneous conditions play Old Harry with the metal markets. It must surely be heartbreaking to producers, individually, to witness that daily sag in the London price at times through inactivity and entire absence of support when a seller appears.

The European zinc industry also badly needs an institute to foster and encourage new uses for the metal. It is suggested that the new cartel might take this particular work in hand, but, in view of its existence being "subject to trial," it is unlikely to overreach itself in this probationary period. With the wonderful success achieved by the Copper and Brass Research Association in the United States before them, we often wonder why the American Zinc Institute has failed to find the financial support necessary to initiate a nation-wide publicity campaign to promote new uses for zinc.

It is electrolytic zinc which is widening in popularity, often, it is true, at the expense of the distilled metal. From the way things are shaping, it looks as if the proportion of high-grade zinc to total zinc production in 1928 will exceed 20 per cent. Last year the 230,000 metric tons produced by electrolytic plants was equal to 17 per cent of the world output, and the proportion will be one-quarter at least by 1930.

The British galvanizing trade, after rather a quiet spell, has accepted a rather heavy volume of export business for shipment up to and including September, with the result that its order books make a better showing than at any previous time this year. On the Continent, the sheet zinc trade has also registered an improvement lately.

Stocks, as expected, are now slowly diminishing, thus evidencing the fact that at present world consumption is just slightly ahead of production. Our estimate of world stocks on July 1, 1928, is as follows:

	Metric Tons
United States	40,300
Canada	4,500
Germany-Poland	3,800
Belgium	5,200
France	1,500
Great Britain	1,300
Scandinavia	200
Other Europe	600
Australia	4,000
Far East	800
Elsewhere	2,000
Total	64,200

McIntyre Porcupine Annual Report Indicates Profitable Operation

ANNUAL report of the McIntyre Porcupine Mines, Ltd., for the fiscal year ended March 31, 1928, shows net earnings of $1,800,363 before depletion or depreciation in that period. The accompanying profit-and-loss statement reflects the financial status of the year's operations.

Profit-and-Loss Statement

April 1, 1927, to March 31, 1928

Bullion recovery		$3,987,634
Operating costs:		
Mining and development	$1,506,349	
Crushing and conveying	69,100	
Milling	376,146	
Miscellaneous camp costs	59,404	
	$2,011,000	
Administrative and general expense:		
Management and general expense—mine	$81,854	
Administrative and general expense, Toronto office	80,828	
Transfer, registrar and stock issue expense	9,083	
Insurance	17,253	
	$189,021	
Total operating costs—before providing for taxes and depreciation		$2,200,022
Operating profit—before providing for taxes and depreciation		$1,787,612
Non-operating revenues:		91,785
		$1,879,398
Appropriations:		
Provision for municipal, provincial and dominion taxes for current year		79,034
Net profit for year—before depreciation provision — transferred to surplus account		$1,800,363

Surplus Account

Surplus as at April 1, 1927		$3,200,907
Net profit, year ended March 31, 1928, before providing for depreciation		1,800,363
		$5,001,270
Dividends	$798,000	
Development undistributed—written off	283,873	
Provision for depreciation, buildings and equipment	349,910	
Sundry adjustments	5,931	
		1,437,715
Surplus as at March 31, 1928		$3,563,555

A total of 520,460 tons of ore was milled during the period, having an average metal content valued at $8.09 per ton.

Michigan Copper Mines Realized 1.84c. per Pound in 1927

ACCORDING to F. G. Pardee, state appraiser of mines of Michigan, the average profit per pound of copper produced in 1927 was 1.8392c. Michigan copper production for 1927 was 177,537,775 lb., an increase of 2,096,210 lb. over 1926. This is the largest output recorded by the state since 1919, when 178,365,000 lb. was produced. The average price per pound received for copper in 1927 was 13.2801c., against 14.18c. in 1926. The average price received during the last five years is 13.9219c. per pound.

Details of costs of producing a pound of copper by Michigan plants are shown in the accompanying table:

Average Cost per Pound Michigan Copper Production In 1927

	Cost in Cents Per Pound
General Expense	
General property tax	.4875
State corporation tax	.0464
Depreciation	1.2452
General office	.1293
Other general expense	.4739
	2.3823
Mining Cost	
Labor	4.0946
Supplies	2.4850
Total	6.5796
Treatment Cost	
Transportation (ore to mill)	.3577
Concentrating	.9872
Transportation to smelter	.0396
Smelting and refining	.7201
Total	2.1046
Selling and delivery expense	.4173
Total gross cost	11.4838
Silver credit	.0511
Net cost	11.4409
Average price of copper	13.2801
Average profit	1.8392

Valuations of mines in the Michigan copper district, as recommended to the state appraisers of mines, are as follows:

Keweenaw County	
Calumet & Hecla Consolidated	$6,030,000
Mohawk Mining Company	2,030,000
Seneca Copper Mining Company	875,000
Houghton County	
Calumet & Hecla Consolidated	13,155,000
Copper Range Company	2,950,000
Isle Royale Copper Company	1,250,000
Quincy Mining Company	800,000
Arcadian Consolidated Copper	110,000
Franklin Mining Company	100,000
Mayflower-Old Colony Copper	80,000
Hancock Consolidated Copper	49,000
La Salle Copper Company	80,000
Superior Copper Company	20,000
Winona Copper Company	65,000
Total	$27,594,000

India Silver Imports for the week ended July 7 totaled 1,807,000 oz., according to a cable dispatch to the U. S. Department of Commerce from its Bombay office. The imports originated from the following points: Port Said, 516,000 oz.; London, 20,000 oz.; and New York, 1,271,000 oz. During the preceding week the imports totaled 527,000 oz. Currency in reserve on June 30 totaled 974,500,000 rupees in silver coins, compared with 968,000,000 rupees on June 22. Bullion in reserve was 35,800,000 rupees, being an increase of 1,000,000 rupees since June 22. Silver stocks were estimated on July 7 at 4,800 bars, showing an increase of 1,200 bars.

Freight Rates on Metals, Ores, and Concentrates

Carload Lots

Copper Bullion and Refined Copper

From	To	Rate per Ton of 2,000 Lb. All Rail	Via Gulf
El Paso, Tex.	Baltimore, Md.	$11.40	$9.40
Garfield, Utah	Perth Amboy	12.50	.....
Garfield, Utah	San Francisco	5.85	.....
Hayden, Ariz.	Perth Amboy	14.50	12.50
Miami, Ariz.	Perth Amboy	14.50	12.50
Anaconda, Mont.	Perth Amboy	12.50	.....
Butte, Mont.	Perth Amboy	12.50	.....
Humboldt, Ariz.	Chrome, N. J.	14.50	12.50
Douglas, Ariz.	Perth Amboy	14.50	12.50
Globe, Ariz.	Perth Amboy	14.50	12.50
Clifton, Ariz.	Perth Amboy	14.50	12.50
Clarkdale, Ariz.	Chrome, N. J.	14.50	12.50
Copperhill, Tenn.	Laurel Hill, N. Y.	$10.80	.....
Tooele, Utah	Chrome, N. J.	12.50	.....
McGill, Nev.	Baltimore, Md.	12.90	.....
Houghton, Mich.	New York	9.60	.....
Hancock, Mich.	New York	9.60	.....
Hubbell, Mich.	New York	9.60	.....
Dollar Bay, Mich.	New York	9.60	.....
Anaconda, Mont.	Tacoma, Wash.	7.09	.....
Ajo, Ariz.	New York	14.50	$12.50

Marine Freight Rates

New York to		
Hamburg	$6.50	per gross ton copper and lead
Liverpool	6.50	per gross ton copper and lead
Antwerp	4.00	per gross ton copper and lead
Havre	5.00	per gross ton lead
	5.25	per gross ton copper
Gulf ports to		
Hamburg	$4.50	per gross ton lead and zinc
Liverpool	4.75	per gross ton lead and zinc
Antwerp	4.00	per gross ton lead and zinc
Havre	4.00	per gross ton lead and zinc
Pacific coast ports to		
Hongkong	$5.00	per short ton copper and lead
Kobe	4.00	per short ton copper and lead

Lead Bullion (Pig Lead Where Shown)

From	Rates per Ton of 2,000 Lb. To New York		To St. Louis
East St. Louis, Ill.	$7.00		.....
Leadville, Colo.	12.50		$9.00
East Helena, Mont.	12.50		9.50
El Paso, Tex.	10.00	Via Gulf	
	12.00	All Rail	7.00
Omaha, Neb.	9.60		3.10
Murray, Utah	12.50		9.00
Midvale, Utah	12.50		9.00
Tooele, Utah	12.50		9.00
East Chicago, Ill.	6.40		(a) 1.60
Kellogg, Idaho	13.50		9.50
Carnegie, Pa.	3.80		(a) 5.00
Selby, Calif.	(b)		.....
Herculaneum, Mo.	(a) 8.80		(a) 1.80
Federal, Ill.	7.00		(a) 1.80
Collinsville, Ill.	7.00		(a) .75¼
Granby, Mo.	(a) 10.50		(a) 3.50
Joplin, Mo.	(a) 10.50		(a) 3.50

(a) Pig lead only.
(b) Open rate, via canal.

Slab Zinc

From	Rates per Net Ton to E.St. Louis	New York
Donora, Pa.	(a) $4.60	$3.80
Langeloth, Pa.	(a) 4.60	3.80
Palmerton, Pa.	7.10	3.00
Hillsboro, Ill.	1.40	7.00
Danville, Ill.	1.60	6.40
La Salle, Ill.	1.60	6.70
Springfield, Ill.	3.00	7.00
Cleveland, Ohio	5.80	5.00
Moundsville, W. Va.	4.40	3.80
Van Buren, Ark.	3.80	10.80
Fort Smith, Ark.	3.80	10.80
Bartlesville, Okla.	3.50	10.50
Blackwell, Okla.	3.80	10.80
Henryetta, Okla.	3.80	10.80
Sand Springs, Okla.	3.80	10.80
Cherryvale, Kan.	3.50	10.50
Black Eagle, Mont.	9.40	12.50
Park City, Utah	9.00	12.50
Amarillo, Tex.	5.80	12.80

(a) To St. Louis, Mo.

Zinc Ores and Concentrates

To	From	Rate per Net Ton
Bartlesville, Okla.	Altoona, Kan.	$2.10
	Pittsburg, Kan.	1.09
	Galena, Kan.	1.30
	Joplin, Mo.	1.40
	Iola, Kan.	1.09
	Baxter, Kan.	1.50
	Miami, Okla.	1.40
	Quapaw, Okla.	1.40
	Kansas City, Mo.	1.60
Sand Springs, Okla.	Miami, Okla.	2.20
	Quapaw, Okla.	2.20
	Galena, Kan.	1.50
	Joplin, Mo.	1.50
	Iola, Kan.	2.40
La Harpe, Kan.	Oswego, Kan.	.50
	Parsons, Kan.	.50
Coffeyville, Kan.	Galena, Kan.	1.10
	Joplin, Mo.	1.00
Bartlesville, Okla.	Baxter Springs, Kan.	1.50
	Miami, Okla.	1.40
	Quapaw, Okla.	1.40
Blackwell, Okla.	N.E.O. R.R. Stations	$2.10

Rates on Ores and Concentrates

From	To	Value of Product — Rate $5	$10	$15	$20	$25	$30	$35	$40	$50	$60	$70	$75	$80	$90	$100
Butte, Mont.	Anaconda, Mont.	.22	.22	.22	.22	.22	.22	.22	.22	.22	.22	.22	22	.22	.22	.22
Butte, Mont.	Black Eagle, Mont. (a)	....	....	....	....	....	....	....	1.01	....	....	....	....	....	....	1.01
Great Falls, Mont.	Helena, Mont	....	....	1.50	....	1.69	....	1.91	....	2.36	....	....	....	....	....	2.48
Butte, Mont.	East Helena, Mont	....	....	1.30	....	1.46	....	1.69	....	2.03	....	....	....	....	....	2.14
Paxton, Calif.	Salt Lake Smelters, Utah	....	....	....	....	....	....	....	....	5.50	6.00	6.70	....	7.40	8.10	8.80
Johannesburg, Calif.	Selby, Calif.	....	....	....	2.90	....	3.50	....	4.10	4.70	5.30	5.90	....	6.50	6.80	7.10
Johannesburg, Calif.	Humboldt, Ariz.	....	....	....	3.40	....	4.10	....	4.80	5.50	6.20	6.90	....	7.60	8.00	8.30
Pioche, Nev.	Humboldt, Ariz.	....	....	7.74	....	8.55	....	9.36	....	9.99	....	....	11.25	....	....	12.42
Creede, Colo.	Durango, Colo.	....	....	3.25	3.50	3.75	4.00	....	4.25	4.75	5.25	5.75	6.05	....	....	7.10
Ouray, Colo.	Durango, Colo.	....	....	4.30	4.80	....	5.05	....	5.50	5.90	....	6.30	....	....	....	7.70
Telluride, Colo.	Durango, Colo	....	....	....	4.00	....	4.30	....	4.60	5.10	5.60	6.10	....	6.50	7.00	7.50
Silverton, Colo.	Durango, Colo	....	....	1.40	1.40	....	....	2.20	....	....	....	....	....	2.30	2.55	2.80
Tyrone, N. M.	Douglas, Ariz.	....	....	1.60	2.30	....	2.60	....	2.90	3.20	....	..	3.80	....	....	4.40
Tyrone, N. M.	El Paso, Tex.	....	....	1.40(c)	1.70	....	2.00	....	2.30	2.60	....	..	3.20	....	....	3.80
Lordsburg, N. M.	Douglas, Ariz.	....	1.00	1.30	1.70	....	2.00	....	2.30	2.60	....	....	3.20	....	....	3.80
Lordsburg, N. M.	El Paso, Tex.	....	1.00	1.30	1.80	....	2.10	....	2.40	2.70	....	....	3.30	....	....	3.90
Tombstone, Ariz.	Douglas, Ariz.	....	....	.60	1.30	.90	1.60	....	1.90	2.20	....	....	2.80	....	....	3.40
Tombstone, Ariz.	El Paso, Tex.	....	1.60	1.90	....	2.50	....	....	3.50	3.80	....	....	4.40	....	....	5.00
Ray Junction, Ariz.	Hayden, Ariz.	....	.10	....	.40	....	.50	....	.80	.90	....	....	1.00	....	....	1.10
Sandon, B. C. / Alamo Concentrator, B. C.	Tadanac, B. C.	1.50	1.60	1.70	1.90	2.00	2.50	....	2.60	2.90	3.40	3.50	....	3.70	3.80	3.90
Rossland, B. C.	Tadanac, B. C.	.90	.90	1.00	1.00	1.10	1.50	....	1.60	1.60	1.60	1.70	....	1.70	1.70	1.70
Rossland, B. C.	Tadanac, B. C(d)	.30	.30	.30	.30	.50	.70	....	.80	.80	....	....	....	....	....	....
Republic, Wash.	Tadanac, B. C.	....	2.11	2.56	2.66	2.86	3.84	....	3.84	3.84	4.69	4.89	....	5.19	5.39	5.59

(a) Minimum tonnage of 200 tons per day. (b) In open cars, minimum 80,000 lb. (c) Plus $2.70 per car switching.
(d) Applicable on ore only when shipped in trainload lots of not less than 10 cars and exclusive of switching charges at Rossland.
(e) Copper ore, $1.15.

From	To	Value of Ores and Concentrates — Rate $10	$15	$20	$25	$30	$35	$40	$50	$60	$70	$75	$80	$90	$100
Burke, Idaho (a) (d)	Bradley, Idaho	....	....	....	....	....	....	....	....	.68	....	....	....	....	1.02
Burke and Wallace, Idaho	East Helena, Mont.	....	....	....	....	3.00	....	3.25	3.50	3.75	4.00	.....	4.25	4.50	4.75
Sagel, Idaho	East Helena, Mont.	....	....	....	3.38	....	3.83	....	4.16	....	....	.....	....	.....	4.84
Arizona Tunnel, Idaho	Bradley, Idaho	....	....	....	....	....	....	....	....	.35	....	.....	....	.....	.50
Bayview, Idaho	Bradley, Idaho	....	....	....	....	....	....	....	3.75	....	....	4.37½	....	.....	5.12½
Park City, Utah	Salt Lake Smelters	1.00(e)	1.10	1.25	....	1.50	....	1.75	....	2.00	....	.....	2.25	.....	2.50
Eureka, Utah	Salt Lake Smelters	1.00	1.10	1.25	....	1.50	....	1.75	2.00	2.25	2.50	.....	2.75	3.00	3.25
Tintic, Utah	Salt Lake Smelters	1.00	1.10	1.25	....	1.50	....	1.75	2.00	2.25	2.50	.....	2.75	3.00	3.25
St. Johns, Utah	Salt Lake Smelters	1.00	1.10	1.25	....	1.50	....	1.75	2.00	2.25	2.50	.....	2.75	3.00	3.25
Ophir, Utah	Salt Lake Smelters	1.00	....	1.25	....	1.50	....	1.75	2.00	2.25	2.50	.....	2.75	3.00	3.25
Bingham, Utah	Garfield, Utah	....	.40	....	.75	....	....	....	.95	....	....	1.10	....	....	1.25
Cherry Creek, Nev.	Garfield, Utah (c)	....	....	4.60	....	5.10	....	5.60	6.10	6.60	7.10	.....	7.60	8.10	8.60
Cherry Creek, Nev.	Garfield, Utah (b)	....	3.00	3.20	....	3.90	....	4.60	5.30	6.00	6.70	.....	7.40	.....	.....
Goldfield, Nev.	Salt Lake Smelters	....	4.15	5.10	....	5.80	....	6.50	7.20	7.90	8.60	.....	9.30	10.00	10.70
Battle Mountain(a)	Salt Lake Smelters	....	....	3.20	....	3.80	....	4.40	5.00	5.60	6.20	.....	6.80	7.40	8.00
Palisade, Nev. (a)	Salt Lake Smelters	2.20	2.60	3.20	....	3.80	....	4.30	4.80	5.30	5.80	.....	6.30	6.80	7.30
Mina, Nev. (a)	Salt Lake Smelters	....	....	3.60	....	4.30	....	5.00	5.70	6.40	7.10	.....	7.80	8.50	9.20
Lovelock, Nev. (a)	Salt Lake Smelters	....	....	3.20	....	3.90	....	4.60	5.30	6.00	6.70	.....	7.40	8.10	8.80
Goleonda, Nev. (a)	Salt Lake Smelters	....	....	3.20	....	3.90	....	4.60	5.30	6.00	6.70	.....	7.40	8.10	8.80
Hazen, Nev. (a)	Salt Lake Smelters	....	....	3.20	....	3.90	....	4.60	5.30	6.00	6.70	.....	7.40	8.10	8.80
Tonopah, Nev.	Salt Lake Smelters	....	4.15	5.10	....	5.80	....	6.50	7.20	7.90	8.60	.....	9.30	10.00	10.00
Rogerson, Idaho	Salt Lake Smelters	2.50	2.75	3.50	....	4.00	....	4.50	5.00	5.50	6.00	.....	6.50	7.00	7.07
Georgetown, Colo.	Leadville, Colo	....	....	3.50	....	3.75	....	4.00	5.00	5.00	5.80	.....	5.80	5.80	5.85

(a) Minimum weight, marked capacity of car used, but not less than 80,000 lb. (b) Minimum weight, 80,000 lb. (c) Minimum weight, 40,000 lb.
(d) Crude ore for concentration, 30c. per ton.

The Market Report

Little Change in Metal Markets

New York, July 18, 1928.—Those who have been hoping for "stability" in the non-ferrous metal markets should be well pleased with the situation during the last week. Copper in the domestic market at 14.75c., Connecticut, New York lead and St. Louis zinc both at 6.20c.: these prices have held all week. Sellers refuse to shade and as a consequence every sale of any importance was made at these levels. Although the total volume of sales can hardly be called normal, a fair business has been reported in each of the metals, lead being easily the most active. Lead in St. Louis is quotably a little lower than a week ago, whereas tin has picked up 1½c.

Daily Prices of Metals

July	Electrolytic Copper	Straits Tin	Lead		Zinc
	Refinery	New York	New York	St. Louis	St. Louis
12	14.525	46.00@46.25	6.20	6.05	6.20
13	14.525	46.25	6.20	6.00@6.025	6.20
14	14.525	46.25	6.20	6.00@6.025	6.20
16	14.525	46.25	6.20	6.00	6.20
17	14.525	47.25	6.20	6.00	6.20
18	14.525	47.625@47.75	6.20	6.00	6.20
	14.525	46.635	6.200	6.013	6.200

Average prices for calendar week ending July 14, 1928, are: Copper, 14.527; Straits tin, 46.250; N. Y. lead, 6.200; St. Louis lead, 6.052; zinc, 6.200; and silver, 59.042.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis; that is, delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted, and prices at so-called Middle West destinations, 0.325c. above.

Quotations for copper are for the ordinary form of wire bars and ingot bars. For ingots an extra 0.05c. per pound is charged; for slabs, 0.075c.; and for cakes, 0.125c. up, depending on weight. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

July	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic	Spot	3M	Spot	3M	Spot	3M
	Spot	3M							
12	62 13/16	63 1/16	68 3/4	209	205 1/2	20 7/16	20 7/8	25	24 15/16
13	62 13/16	63 1/16	68 3/4	210 1/4	206 3/4	20 7/16	20 7/8	24 7/8	24 7/8
16	62 7/8	63 3/16	68 3/4	210 1/4	207	20 3/8	20 13/16	24 9/16	24 3/4
17	62 13/16	63 1/8	68 3/4	213	209 1/2	20 5/8	21	24 9/16	24 7/8
18	62 15/16	63 1/4	68 3/4	217 3/4	214	20 5/8	21	24 9/16	24 5/8

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

July	Sterling Exchange "Checks"	Silver		Gold London	July	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
12	4.85 7/8	59 1/4	27 5/16	84s10½d	16	4.85 5/8	59	27⅛	84s10½d
13	4.85 9/16	59⅛	27 7/16	84s10½d	17	4.85 3/8	58 7/8	27 3/16	84s10d
14	4.85 5/8	59⅛	27¼	.....	18	4.85 7/8	58 7/8	27⅛	84s10½d

Avg. 59.042

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-eighths cent premium.

Copper Quiet and Firm

Some, at least, of the important consumers of copper had not covered their needs for August, for the bulk of the tonnage sold during the past week was for delivery in that month. A few small orders were placed for July shipment, and some October metal changed hands, all of it at 14.75c., Connecticut, or on that basis. Foreign sales for the first eighteen days of the month are in the aggregate about 20,000 tons, at the exporters' c.i.f. price of 15c., usual European destinations. Statistics for June reveal some records. Shipments, including foreign and domestic, totaled 138,503 tons from refineries in North and South America; and stocks of refined metal at the end of the month had shrunk to 58,809 tons, a new record for post-war times. At the same time a new high record for production was established during the month; the daily average for the countries that produced 98 per cent of the world's total was 5,221 tons, compared with the previous high of 4,984 in February of this year. Producers are not disturbed by the increased output, declaring that it was necessary to meet the growing demand. In this they are borne out by the reduction in stocks. At the same time it should be recognized that the large deliveries of June, as well as of May and April, may have swelled stocks in consumers' hands to some extent.

Lead More Active; Prices Lower in Middle West

Although the total volume of pig-lead sales for the *E.&M.J.* week ending today is slightly above average, most of these sales have been completed during the first three days of the present calendar week. Faced with indications of a disproportionate easing in demand in the Middle West, the leading interests in that district dropped their price to 6c. per pound late last week. The improvement in demand followed closely this drop in prices. This reduction serves to widen the differential between New York and East St. Louis prices and to place it closer to its normal size. Following several weeks with a narrow differential of $2 to $3 per ton, an increase is but natural, in view of the $7 per ton freight rate between the two points. Cable manufacturers have contracted for slightly more than their usual proportion of the sales tonnage during the week, and corroding lead has been in fair demand. Most sales have been for July delivery, with August specifications of secondary importance. Some orders have been booked as far ahead as September and October, though no particular effort to force forward lead on the market is in evidence.

Zinc Continues at 6.20c.

No less steady than the copper market is that for zinc. Most of the sales are for prompt or July delivery at 6.20c. Sellers would like to get a little more

for August or September, but they have not been able to attract customers at any advance. Total tonnage sold is double that of the preceding week, though hardly up to average. With ore prices still on a $40 basis, producers maintain that they cannot afford to sell slab zinc at less than 6.20c. High-grade is nominal at 7.50c. for spot lots in New York.

Tin Continues Firm at Higher Prices

Following a period of steadiness lasting several days, prices of spot Straits tin advanced abruptly 1c. per pound yesterday to 47¼c. and the price is even higher today. Bears covering in London are credited with causing the upward price movement, for the domestic situation appears virtually unchanged from that prevailing during recent weeks.

Silver Closes Week at 58⅞c.

There has been little business in the local silver market during the week, and prices have been maintained, with narrow movements. India has given moderate support to the market, and reports from abroad state that China has operated both ways. The closing tendency is quiet.

Mexican Dollars (Old Mexican pesos): July 12th, 44¾c.; 13th and 14th, 44⅝c; 16th, 44½c.; 17th and 18th, 44⅜c.

Foreign Exchange

Foreign Exchanges weakened fractionally during the week, except for sterling, which underwent no net change. Closing cable quotations on Tuesday, July 17, were as follows: francs, 3.91⅞c.; lire, 5.24c.; and marks, 23.85¼c. Canadian dollars, ⅛ per cent discount.

Correction: The quotation for sterling exchange for July 10 should have been 4.86⅜, instead of 4.86¾, as published in the issue of July 14.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

ALUMINUM—Per lb., 99 per cent plus grades, price of leading interest, 24.30c. Outside market, 99 per cent plus, 24.30c.; 98-99 per cent, 23.90c.

ANTIMONY—Per lb., duty paid, New York: Chinese brands, near-by, 9½c., futures, 9⅜@9¾c. Cookson's "C" grade, spot, 15⅜c.

BISMUTH—Per lb., New York, in ton lots, $1.70. Smaller lots, $1.85 and up.

CADMIUM—Per lb., New York: 65c. @75c., according to quantity.

IRIDIUM — Per oz., $275@$300 for 98@99 per cent sponge and powder. Market dull.

NICKEL—Per lb. ingot, 35c.; shot, 36c.; electrolytic, 37c. (99.9 per cent grade) for single lots of spot metal.

PALLADIUM — Per oz., $46@$49. Small lots bring up to $55. Nominal.

PLATINUM—Official price quoted by the leading interest on small miscellaneous orders for refined metal, per oz., $78. Dealers and refiners quote the trade for refined metal, per oz., cash, for wholesale lots, $73.50@$74 bid, $75.50@$76.50 asked. Market very quiet.

QUICKSILVER — Per 76-lb. flask, $120@$122, depending on quantity. San Francisco wires $124. Spanish and Italian producers are reported to have signed an agreement recently whereby production will be marketed jointly for a period of ten years.

Prices of Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Osmium, Radium, Rhodium, Ruthenium, Selenium, Tantalum, Tellurium, Thallium, Tungsten, and Zirconium are unchanged from the issue of July 7.

Metallic Ores

MANGANESE ORE—Per long ton unit of Mn, c.i.f. North Atlantic ports, minimum 47 per cent Mn: 35@38c. Caucasian, washed, 53@55 per cent, 38@40c. Chemical grades unchanged from quotations in the July 7 issue.

TUNGSTEN ORE—Per unit of WO_3, N. Y.: Wolframite, $10.75@$10.85, Western scheelite, $10.75@$11.

Chrome, Iron, Tantalum, and Titanium ores are unchanged from quotations in the July 7 issue.

Zinc Price Unchanged—Lead Lowered $2.50 Per Ton

Joplin, Mo., July 14, 1928

Blende		Per Ton
High		$42.05
Premium blende, basis 60 per cent zinc	$40.00@	41.00
Prime Western, basis 60 per cent zinc		40.00
Fines and slimes, 60 per cent zinc	36.00@	39.00
Average settling price, all zinc		39.30
Galena		
High		$84.80
Basis 80 per cent lead		80.00
Average settling price, all lead		83.91

Shipments for the week: Blende, 10,677; lead, 2,374 tons. Value, all ores the week, $618,820.

During the market today all production of the week was subject to sale, and buyers contracted for 11,730 of the 11,760 tons produced. In three months of restriction output has been 21,000 tons less than shipments, reducing stocks in bins to 39,200 tons, from which this week's purchase of 11,730 tons leaves a net reserve of 27,470 tons. Shipments of lead from reserve stocks this week were sold on the basis current last week, with the market today lowered $2.50 per ton.

Platteville, Wis., July 14, 1928

Zinc Blende	Per Ton
Blende, basis 60 per cent	$42.75
Lead Ore	
Lead, basis 80 per cent	$81.00

Shipments for the week: Blende, 911 tons; lead, 160 tons. Shipments for the year: Blende, 20,243 tons; lead, 1,245 tons. Shipments for the week to separating plants, 970 tons blende.

Platteville, Wis., July 7, 1928

Zinc Blende	Per Ton
Blende, basis 60 per cent	$42.75
Lead Ore	
Lead, basis 80 per cent	$81.00

Shipments for the week: Blende, 473 tons; lead, none. Shipments for the year: Blende, 19,332 tons; lead, 1,085 tons. Shipments for the week to separating plants, 1,163 tons blende.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystal, Silica, Spodumene, Sulphur, Talc, and Tripoli are unchanged from prices in the July 7 issue.

Metallic Compounds

ARSENIOUS OXIDE (White Arsenic) —Per lb., 4c. Several carloads sold.

Antimony Oxide, Calcium Molybdate, Copper Sulphate, Sodium Sulphate (Salt Cake), Sodium Nitrate, and Zinc Oxide are unchanged from prices in the July 7 issue.

Alloys

FERROMANGANESE—Per long ton, domestic and foreign, f.o.b. furnace or duty paid, port of entry, $105 quoted for last half, 1928. Spiegeleisen, 19@21 per cent, $32 f.o.b. furnace.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent, 96@98c. f.o.b. works.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrophosphorus, Ferrosilicon, Ferrotitanium, Ferrovanadium, Monel Metal, Nickel Silver and Yellow (Muntz) Metal are unchanged from prices in the July 7 issue.

Rolled Metals

Copper, Lead, and Zinc Sheets are unchanged from prices in the July 7 issue.

Refractories

Chrome Brick, Fireclay Brick, Magnesite Brick, Silica Brick and Zirkite are unchanged from quotations in the issue of July 7.

Iron, Steel, and Coke

Iron—Per gross ton, Valley furnaces, Bessemer, $17; basic, $15.75@$16; No. 2 foundry, $16.50@$16.75.

Steel—Base prices per gross ton, Pittsburgh, billets rerolling, $32; slabs, $32@$33; plates, structural shapes, and soft steel bars, per pound, 1.85@1.90c. On July 17, Carnegie Steel announced an advance over these quotations, of $2 a ton on bars, plates, and shapes for fourth-quarter delivery.

Coke—Per gross ton, Connellsville furnace, contract, $2.75@$3; spot, $2.60@$2.75. Connellsville foundry, contract, $3.50@$4.85; spot, $3.50@$4.50. By-product coke, Ohio and Kentucky. $7; Buffalo and Detroit, $8.50@$9.

Mining Stocks—Week Ended July 14, 1928

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda	New York	69⅜	65¼	66⅜	Jl.14, Au. 20 Q	1.00
Ariz. Com'l	Boston	5⅜	4⅜	4⅜	Jl. 16, Jl. 31 SA	0.25
Cal. & Ariz	New York	99½	94½	95	Je. 8, Je. 25 Q	1.50
Calumet & Hecla	Boston	23½	21½	22	My. 31, Je. 15 Q	0.50
Cerro de Pasco	New York	78½	73½	74½	Jl.12, Au. 1 Q	1.25
Chile Copper	New York	46⅜	44⅜	44⅜	Je.6, Je.30 Q	0.62½
Con. Coppermines	N. Y. Curb	11½	10⅞	10⅞		
Copper Range	Boston	19½	17½	18	Mr. 24, Ap. 20 A	1.00
Crystal Copper	Boston Curb	*46	*39	*46		
East Butte	Boston	2⅜	2⅛	2⅜	Dec., 1919	0.50
Granby Consol	New York	55	51⅜	52⅜	Jl.13, Au.1 Q	1.00
Greene Cananea	New York	107⅞	95	98⅛	Je. 15, Jl. 2	1.00
Howe Sound	New York	59½	56	57½	Je.30, Jl.16, Q	1.00
Inspiration Consol	New York	22⅜	21⅛	21⅜	Apr. 1927 Q	0.25
Isle Royale	Boston	20	17½	17½	Fe.28, Mr.15 SA	0.50
Kennecott	New York	93½	90⅜	92⅜	Jl. 1, Jl. 2 Q	1.25
Magma Copper	New York	52⅜	49½	49½	Jl.29, Jl.16 Q	0.75
Mason Valley	N. Y. Curb	1⅛	1⅛	1⅛		
Miami Copper	New York	21	19⅜	20⅛	Au.1, Au.15, Q	0.37½
Mohawk	Boston	59	57	58	Jl. 31, Se. 1 Q	1.00
Montana-Idaho	Spokane	*22	*15	*20		
Mother Lode Coal	New York	2⅜	2⅛	2⅜	Je.8, Je. 30, SA	0.15
Nevada Consol	New York	23	21½	22⅜	Je.15, Je.30 Q	0.375
New Cornelia	Boston	*30	*28	29	My. 4, My. 21 Q	0.50
Noranda	N. Y. Curb	55⅞	47⅜	52⅛		
North Butte	Boston	4⅛	2⅜	4	Oct., 1918	0.25
Ohio Copper	N. Y. Curb	*84	*71	*84	Sept., 1926	0.03
Old Dominion	Boston	17	13	16	Dec., 1918	1.00
Phelps Dodge	N. Y. Curb	132	132	132	Je.25, Jl.22 Q	2.00
Quincy	Boston	44½	37½	41	March, 1920	1.00
St. Mary's Min. Ld	Boston	30	28	29	Ap.1928 A	2.00
Seneca Copper	New York	2⅞	2⅛	2⅛		
Shattuck-Denn	N. Y. Curb	15⅛	14⅜	14⅜		
Tenn. C. & C	New York	14⅛	13⅛	13⅜	My.29, Je.15,Q	0.12½
United Verde Ex	N. Y. Curb	15	14½	15	July 6, Q	0.50
Utah Copper	New York			159	Je.15, Je.30 Q	1.50
Utah Metal & T	Boston	1⅛	1 1/16	1 1/16	Dec., 1917	0.30
Walker Mining	Salt Lake	1.30	1.25	1.27½		
NICKEL-COPPER						
Internat. Nickel	New York	97⅜	88⅜	91¼	Je.14, Je.30 Q	0.50
Internat. Nickel pfd.	New York	115⅛	115¼	115⅛	Jl.12, Au.1 Q	1.50
LEAD						
Gladstone Mtn	Spokane	3.75	3.00	3.25	June, 1927	0.005
National Lead	New York	121½	115	116½	Je.15, Je.30 Q	1.25
National Lead, pfd. A	New York	144½	144½	144½	Je.1, Je.15 Q	1.75
National Lead, pfd. B	New York	120⅜	120⅜	120⅜	Jl. 20, Au. 1 Q	1.50
St. Joseph Lead	New York	44½	39	41½	Je.9, Je.20, QX	0.75
ZINC						
Am. Z. L. & S	New York	27⅜	23½	24⅞	May, 1917	1.00
Am. Z. L. & S. pfd	New York	87	82	83½	Nov., 1920	1.50
Butte C. & Z	New York	7⅞	6	6⅛	Dec., 1926	0.50
Butte & Superior	New York	12⅜	11½	11⅞	Je.15,Je.30 Q	0.50
Callahan Zn-Ld	New York	3½	2⅞	3	De., 1920	0.50
Consol.Lead&Zinc 'A'	St. Louis	13¼	13¼	13¼	Je.25, Jl.1 Q	0.25
Eagle-Picher	Cincinnati	17¼	16¼	17	No.15, De.1 Q	0.40
Eagle-Picher pfd	Cincinnati	100	100	100	Mr. 31, Ap. 16 Q	1.50
New Jersey Zn	N. Y. Curb	218½	216	216	Jl. 20, Au. 10 X	2.00
Treadwell-Yukon	Toronto	20.50	17.60	18.25		
United Zinc	N. Y. Curb			*60		
Yellow Pine	Los Angeles	*30	*25	*25	Dec., 1925 QX	0.04
GOLD						
Alaska Juneau	New York	4⅛	3⅛	3⅞		
Ankerite	Toronto	*40	*35	*40		
Barry-Hollinger	Toronto	*62	*55	*56		
Central Manitoba	Toronto	1.32	*90	1.06		
Cresson Consol. G	N. Y. Curb	1 1/16	1⅛	1⅛	Je.30, Jl.10 Q	0.10
Dome Mines	New York	8⅜	8⅛	8⅜	Je.30, Jl.20 Q	0.25
Golden Cycle	Colo.Springs	†1.68	†1.67		My. 31, Je.10 Q	0.04
Gold Hill	Toronto	*10¼	*8⅛	*8⅜		
Hollinger Consol	Toronto	13.75	12.85	12.85	Je.27, Jl.14 FW	0.10
Homestake Mining	New York	73	73	73	Jl.20, Jl.25 M	0.50
Kirkland Lake	Toronto	1.57	1.30	1.45		
Lake Shore	Toronto	23.05	22.00	22.50	Je.1, Je.15 QX	0.20
McIntyre Porcupine	New York	24¼	22	24¼	May1, Je.1 Q	0.25
Portland	Colo.Springs	†*20	†*17		Ap., 1927	0.02
Rand Mines	New York			39½	Fe.21-28 Am.Sh.	1.52
Sylvanite	Toronto	2.70	2.35	2.43		
Teck-Hughes	Toronto	11.00	10.55	10.65	Jl. 17, Au. 1 SAX	0.15
Tom Reed	Los Angeles	*42	*37½	*40	Dec., 1926	0.02
Tough-Oakes	Toronto	*27	*24	*25½		
Vipond Cons	Toronto	*59	*47	*50½	April, 1927	0.03
Wright-Hargreaves	Toronto	4.09	3.25	3.55	Ap.13, My.1 Q	0.05
GOLD AND SILVER						
Carnegie Metals	N. Y. Curb	19	18⅜	18⅜		
Con. Cortez	N. Y. Curb	*30	*27	*27		
Dolores Esperanza	N. Y. Curb	1.00	*80	*98	July, 1923	0.05
N.Y. Hond's Rosario	N. Y. Curb			15	Jl.18, Jl.28 Q	0.50
Premier Gold	N. Y. Curb	2⅜	2⅛	2⅛	Je.14, Jl.3	0.06
Tonopah Belmont	N. Y. Curb	*90	*90	*90	Oc., 1925	0.05
Tonopah Extension	N. Y. Curb	*13	*13	*13	Ap., 1925	0.05
Tonopah Mining	N. Y. Curb	1⅛	1⅛	1⅛	Mar.31,Ap.21 SA	0.07½
West End Consol	N. Y. Curb	*5	*5	*5	Mar., 1923	0.05
Yukon Gold	Boston Curb	*75	*70	*70	June, 1918	0.02
SILVER						
Beaver Consol	Toronto	*94	*87	*92	May, 1920	0.03
Castle-Trethewey	Toronto	*51	*45	*51		
Coniagas	Toronto	5.00	4.24	4.90	May, 1924	0.12½
Keeley	Toronto	*62	*60	*61	Mr.1, Mr.15 SA	0.04
Lorrain Trout Lake	Toronto			*50	July, 1925	0.05
Mining Corp. Can	Toronto	3.78	3.45	3.57	My.27, Je.13 SA	0.125
Nipissing	N. Y. Curb	3⅛	3⅛	3⅛	Je.30, Jl.20Q	0.075

Stock	Exch.	High	Low	Last		Last Div.
SILVER-LEAD						
Ahumada	New York	3⅛	3⅛	3⅛	Ap., 1927	0.12½
Bingham Mines	Boston	44	41½	44	Je.23, Jl.5 Q	1.00
Bunker Hill & Sullivan	N. Y. Curb			140	Je.30, Jl.5 QX	0.75
Cardiff M. & M	Salt Lake	*65	*65	*65	Feb. 5, 1927	0.10
Chief Consol	Salt Lake	4.35	4.20	4.20	Ja.10, Fe.1 K	0.10
Consti'nMng.&Mill'g.	Spokane	*25	*21	*22		
Erupcion	Boston Curb			*28	Dec. 13, Jan. 3,	0.07½
Eureka Lily	Salt Lake	2.10	2.00	2.05		
Federal M. & S	New York	126	125	125	Je., 1927	10.00
Federal M. & S. pfd	New York			98	My.25, Je.15 Q	1.75
Hecla Mining	N. Y. Curb	15⅞	15	15⅛	My.15, Je.15 Q	0.15
Highland-Surprise	Spokane	*12	*11	*11½		
Iron King Mining	Salt Lake	*76	*68	*69		
Keystone Mining	Salt Lake	*26	*26	*26	Fe., 1926	0.07½
Lucky Jim	Spokane	*31	*30½	*30½		
Lucky Tiger-Com	Kansas City	†7.85	†7.70		Je.7,.Je.20MX	0.07
Mammoth Mining	Salt Lake	†1.55	†1.25		De., 1926	0.25
North Lily	Salt Lake	7.90	7.85	7.85		
Park Utah	New York	12⅛	11	11⅛	Je.15, Jl.2 Q	0.20
Plutus Mining	Salt Lake	†2.00	†1.90		Ap.10, Ap.16 Q	0.10
Rico-Argentine	Salt Lake	*42	*40	*41	June 15 Q	0.03
Silver King Coal	Salt Lake	11.75	11.50	11.75	Je.20, Jl.2 Q	0.25
Silversmith	Spokane	*13¼	*12	*13	Oct., 1926 Q	0.02
Strattons Mines	Spokane	*79	*72	*79		
Sunshine M. Co	Spokane	1.38	1.20	1.37	June 20,	0.02
Tamarack-Custer	Spokane	*58⅛	*48	*50⅛	Sept., 1924	0.25
Tintic Standard	Salt Lake	14.12½	13.75	13.75	Je.18, Je.30 QX	0.30
Utah-Apex	Boston	4⅛	3⅛	3⅛	Jl.14, Au.1 1926	0.25
IRON						
Bethlehem Steel	New York	56⅜	53⅛	54⅛	Jl., 1924	1.25
Cleveland-Cliffs Iron	Cleveland	110	104½	109	Jl.14, Jl.25. Q	1.00
Colorado Fuel & Iron	New York	64⅜	56⅛	58⅜	May, 1921	0.75
Gt. North'n Iron Ore	New York	20⅛	20⅛	20⅛	Ap. 9, Ap. 30 K	0.75
Inland Steel	New York	55⅜	54	55	My. 15, Je.1 Q	0.62½
Republic I. & S	New York	53	50	53	My.15, Je.1 Q	1.00
Republic I. & S. pfd	New York	104½	104½	104½	Je. 15, Jl. 2 Q	1.75
Sloss-Sheffield S. & I	New York	102½	102½	102½	Je.9, Je.20 Q	1.50
Sloss-Snef. S.&I. pfd	New York			115½	Je. 20, Jl. 2 Q	1.75
U. S. Steel	New York	141⅞	134⅛	136	My.31, Je.29 Q	1.75
U. S. Steel, pfd	New York	141⅞	141⅛	141⅛	Ap. 30, My. 29 Q	1.75
Virginia I. C. & C	New York			14⅛	Jan., 1924	1.50
Virginia I.C.&C. pfd	New York	53	52⅛	52⅛	Je. 16, Jl. 2 SA	2.50
DIAMONDS, PLATINUM, ALUMINUM, VANADIUM, TIN						
De Beers Consol	New York			25⅜	July., 1927	1.45
So. Am. G. & P	N. Y. Curb	3⅛	3	3⅛		
Alum. Co. of Amer	N. Y. Curb	147	140	140		
Alum. Co. of Amer. pf.	N. Y. Curb	108⅛	108⅛	108⅛	Je. 15, Jl. 1 Q	1.50
Vanadium Corp	New York	76⅛	68⅛	70	My. 1, My. 15 Q	0.75
Patino M. & E	New York	31⅛	28⅞	29⅛	April, 1928	4s.
ASBESTOS						
Asbestos Corp	Montreal	32⅜	32⅛	32⅛	Jan., 1926	1.50
Asbestos Corp. pfd	Montreal	93	91⅛	92	Jl. 30, Jl. 16 Q	1.75
SULPHUR						
Freeport Texas	New York	72⅛	67⅜	68⅛	Jl.14,Au.1 QX	1.75
Texas Gulf	New York	70⅜	65⅞	67⅛	Je.1, Je.15 Q	1.00
MINING, SMELTING, REFINING AND GENERAL						
Amer. Metal	New York	50⅜	47⅛	47⅞	Au. 21, Se.1 Q	0.75
Amer. Metal, pfd. 6%	New York	113½	112½	112½	Au.15, Se.1 Q	1.50
Amer. Met. pfd. 7%	New York			125	My.15, Je.1	1.75
Amer. Sm. & Ref	New York	194½	187⅛	188⅛	Jl 13, Au.1 Q	2.00
Amer. Sm. & Ref. pfd	New York	135	135	135	Au. 3, Se. 1 Q	1.75
Consol. M. & S	Montreal	261	251	252½	Je.30, Jl.16 SAX	6.25
Newmont Mining	N. Y. Curb	163¾	153½	155	Je.30, Jl.16 Q	1.00
U. S. Sm. R. & M	New York	48	44¼	47⅛	Jl. 5, Jl. 14 Q	0.87½
U.S. Sm. R.&M. pfd	New York	53⅜	53	53	Jl. 5, Jl. 14 Q	0.87½

*Cents per share. †Bid or asked. Q, Quarterly. A, Annual. SA, Semi-annually. M, Monthly. FW, four weeks. K, irregular. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, J. A. Hogle & Co.; Colorado Springs, Colo., Henry Sachs.

LONDON QUOTATIONS—WEEK ENDED July 3, 1928 — Last Div.

Name	High	Low	Last	Date	Amount
Alaska Mexican ($5)	38/—	37/6	37/6		
Alaska Treadwell ($25)	122/6	120/—	120/—	Nov., 1926	4 (d)
Aramayo Mines (25 frs.)	66/3	62/6	65/—	May, 1928	5 p.c. (†)
Burma Corpn. (10 rupees)	14/4½	14/—	14/1½	Aug., 1928	6 annas*
Bwana M'Kubwa (5s)	5/—	4/7½	5/—		
Camp Bird (2s)	4/4½	4/3	4/4½	April, 1928	16⅔ p.c.
El Oro (£1)	4/6	4/1½	4/6	Nov., 1924	2½ p.c.*
Frontino & Bolivia (£1)	13/—	12/6	12/6	Jan., 1928	5 p.c.
Mexican Corpn.(£1)	10/9	10/—	10/3		
Mexico Mines of El Oro (£1)	29/4½	21/—	25/—	Dec., 1926	3¾ p.c.*
Mond Nickel	186/10½	177/6	178/9	Aug., 1928	20 p.c.
N'Changa Copper Mining	16/3	15/7½	15/9		
Oroville Dredging (£1)	3/9	3/7½	3/9	Dec., 1923	3¾ p.c.
Rhodesian Congo Border (£1)	36/3	30/—	36/3		
St. John del Rey (£1)	12/9	12/1½	12/3	April, 1928	7½ p.c.
San Francisco Mines (10s)	28/6	27/4½	28/6	July 1928	12½s.
Santa Gertrudis (£1)	17/—	16/1½	16/9	July 1928	7½ p.c.
Selukwe (2s. 6d.)	14/—	11/1½	11/3	April, 1917	6¾ p.c.
S. Amer. Copper (2s.)	2/9	2/—	2/4½	Nov., 1917	75 p.c.
Tanganyika (£1)	60/3	54/6	58/9	Aug., 1927	7½ p.c.
Union Miniere de Haut-Katanga (Brussels)	11,100	10,900	11,100	July, 1927	182.60 (‡)

*Free of British income tax. †Swiss francs and plus 15 p. c. bonus. ‡Belgian frs. and free of taxation. §U. S. Dollars.